B I O L O G I C A L A S S E S S M E N T

Suisun Marsh Preservation Agreement as Modified by Amendment Three

October 1999

PREPARATION OF THE SUISUN MARSH PRESERVATION AGREEMENT AMENDMENT THREE BIOLOGICAL ASSESSMENT

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Contents

Figures

Tables

Chapter 1
INTRODUCTION

The purpose of this biological assessment is to review the Suisun Marsh Preservation Agreement (SMPA) as modified by Amendment Three in sufficient detail to determine if the proposed actions may affect any of the threatened, endangered, proposed, or sensitive species listed in Table 1 below. This biological assessment is prepared in accordance with legal requirements set forth in Section 7 of the Endangered Species Act (16 U.S.C. 1531 et seq).

This biological assessment addresses the potential effects of the Suisun Marsh Preservation Agreement as modified by Amendment Three. Information from existing assessments and environmental evaluations were used and incorporated where appropriate. A *Draft Environmental Assessment and Initial Study* (SMPA 1998) for Amendment Three of the Suisun Marsh Preservation Agreement, a detailed description of the actions proposed, and an analysis of the potential effects, was prepared by the US Bureau of Reclamation (USBR), California Department of Fish and Game (DFG), California Department of Water Resources (DWR), and the Suisun Resource Conservation District (SRCD) and was released in June 1998 (SMPA 1998).

At the request of USBR and to fulfill requirements of section 7(c) of the Endangered Species Act of 1973, the USFWS provided a list of sensitive species that may be present in or affected by activities in the project area. The list provided includes all species observed within US Geological Survey (USGS) quad maps that include the project area; therefore, all of the species included on the USFWS list are not in the specific project area.

The species included and assessed in this document are presented in Table 1. Sensitive species not known to exist in the project area and not considered in this document are presented in Table 2.

The proposed Amendment Three actions addressed will occur near or within critical habitat designated for delta smelt and winter-run chinook salmon. On 16 June 1993, the National Marine Fisheries Service (NMFS) designated critical habitat for winter-run chinook salmon from Keswick Dam to the Golden Gate Bridge. On 18 January 1995, the US Fish and Wildlife Service (USFWS) designated critical habitat for delta smelt in the following areas: Suisun Bay, Goodyear, Suisun, Cutoff, First Mallard, and Montezuma sloughs; and existing contiguous waters contained within the Sacramento-San Joaquin Delta (Delta).

Background

On 2 March 1987, USBR, DWR, DFG, and SRCD signed the original SMPA to mitigate for changes in Delta outflow and Suisun Marsh salinities caused by operation of the Central Valley Project (CVP), State Water Project (SWP), and other upstream diversions. The SMPA was developed to provide facilities that would protect the brackish water of the Suisun Marsh (Figure 1) and to enable DWR and USBR to meet the water quality conditions and Program of Implementation specified in Decision 1485 (D-1485) (the Initial Facilities, salinity standards, and monitoring) required by the State Water Resources Control Board (SWRCB).

Table 1 Species considered in this assessment from the USFWS list dated 13 July 1998

Common Name	*Scientific Name*	*Status*[a]
Endangered, Threatened, or Proposed Endangered or Threatened		
Mammals		
salt marsh harvest mouse	*Reithrodontomys raviventris halicoetes*	E
Birds		
Aleutian Canada goose	*Branta canadensis leucoparela*	T
western snowy plover	*Charadrius alexandrinus nivosus*	T
bald eagle	*Halieetus leucocephalus*	T
American peregrine falcon	*Falco peregrinus anatum*	E
California clapper rail	*Rallus longirostris obsoletus*	E
California least tern	*Sterna antillarum (albifrons) browni*	E
Fish		
delta smelt	*Hypomesus transpacificus*	T
Central Valley steelhead	*Oncorhynchus mykiss*	T
winter-run chinook salmon	*Oncorhynchus tshawytscha*	E
Central Valley spring-run chinook salmon	*Oncorhynchus tshawytscha*	PE
Central Valley fall-run chinook salmon	*Oncorhynchus tshawytscha*	PT
Sacramento splittail	*Pogonichthys macrolepidotus*	T
Amphibians		
California red-legged frog	*Rana aurora draytonii*	T
Plants		
Suisun thistle	*Cirsium hydrophilum* var. *hydrophilum*	E
soft bird's-beak	*Cordylanthus mollis* subsp. *mollis*	E
Species of Concern and Candidate Species		
Mammals		
greater western mastiff-bat	*Eumops perotis californicus*	SC
small-footed myotis bat	*Myotis ciliolabrum*	SC
long-eared myotis bat	*Myotis evotis*	SC
fringed myotis bat	*Myotis thysanodes*	SC
long-legged myotis bat	*Myotis volans*	SC

[a] E = Endangered; T = Threatened; P = Proposed; C = Candidate; SC Species of Concern.

Table 1 (Continued) Species considered in this assessment from the USFWS list dated 13 July 1998

Common Name	*Scientific Name*	*Status*[a]
Yuma myotis bat	*Myotis yumanensis*	SC
Pacific western big-eared bat	*Corynorhinus (*Plecotus*) townsendii townsendii*	SC
Suisun ornate shrew	*Sorex ornatus sinuosus*	SC
Birds		
western burrowing owl	*Athene cunicularia hypugea*	SC
American bittern	*Botaurus lentiginosus*	SC
ferruginous hawk	*Buteo regalis*	SC
saltmarsh common yellowthroat	*Geothlypis trichas sinuosa*	SC
Suisun song sparrow	*Melospiza melodia maxillaris*	SC
white-faced ibis	*Plegadis chihi*	SC
tricolored blackbird	*Agelaius tricolor*	SC
Reptiles		
northwestern pond turtle	*Clemmys marmorata*	SC
southwestern pond turtle	*Clemmys marmorata pallida*	SC
Fish		
green sturgeon	*Acipenser medirostris*	SC
Pacific lamprey	*Lampetra tridentata*	SC
longfin smelt	*Spirinchus thaleichthys*	SC
Plants		
Suisun Marsh aster	*Aster lentus*	SC
alkali milk-vetch	*Astragalus tener* var. *tener*	SC
heartscale	*Atriplex cordulata*	SC
brittlescale	*Atriplex depressa*	SC
valley spearscale	*Atriplex joaquiniana*	SC
delta tule pea	*Lathyrus jepsonii var. jepsonii*	SC
Mason's lilaeopsis	*Lilaeopsis masonii*	SC

[a] E = Endangered; T = Threatened; P = Proposed; C = Candidate; SC Species of Concern.

Table 2 Species that are not considered in this assessment but are included in the USFWS list dated 13 July 1998

Common Name	*Scientific Name*	*Critical Habitat*	*Status*[a]
Mammals			
San Joaquin kit fox	*Vulpes macrotis mutica*		E
San Francisco dusky-footed woodrat	*Neotoma fuscipes annectens*		SC
San Joaquin pocket mouse	*Perognathus inornatus*		SC
riparian (San Joaquin Valley) woodrat	*Neotoma fuscipes riparia*		PE
riparian brush rabbit	*Sylvilagus bachmani riparius*		PE
Birds			
grasshopper sparrow	*Ammodramus savannarum*		SC
mountain plover	*Charadrius montanus*		C
lark sparrow	*Chondestes grammacus*		SC
San Pablo song sparrow	*Melospiza melodia samuelis*		SC
California brown pelican	*Pelecanus occidentalis californicus*		E
Reptiles			
silvery legless lizard	*Anniella pulchra pulchra*		SC
San Joaquin whipsnake	*Masticophis flagellum ruddocki*		SC
Alameda whipsnake	*Masticophis lateralis euryxanthus*		T
California horned lizard	*Phrynosoma coronatum frontale*		SC
giant garter snake	*Thamnophis gigas*		T
Amphibians			
California tiger salamander	*Ambystoma californiense*		C
foothill yellow-legged frog	*Rana boylii*		SC
western spadefoot toad	*Scaphiopus hammondii*		SC
Fish			
river lamprey	*Lampetra ayresi*		SC
Invertebrates			
Ciervo aegialian scarab beetle	*Aegialia concinna*		SC
Antioch Dunes anthicid beetle	*Anthicus antiochensis*		SC
Sacramento anthicid beetle	*Anthicus sacramento*		SC
Lange's metalmark butterfly	*Apodemia mormo lan gei*		E
Antioch cophuran robberfly	*Cophura hurdi*		SC
Conservancy fairy shrimp	*Branchinecta conservatio*		E
vernal pool fairy shrimp	*Branchinecta lynchi*		T
valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*		T
Antioch efferian robberfly	*Efferia antiochi*		SC

[a] E = Endangered; T = Threatened; P = Proposed; C = Candidate; SC = Species of Concern.

Table 2 (Continued) Species that are not considered in this assessment but are included in the USFWS list dated 13 July 1998

Common Name	*Scientific Name*	*Critical Habitat*	*Status*[a]
delta green ground beetle	*Elaphrus viridis*	X	T
Ricksecker's water scavenger beetle	*Hydrochara rickseckeri*		SC
curved-foot hygrotus diving beetle	*Hygrotus curvipes*		SC
Middlekauf's shieldback katydid	*Idiostatus middlekaufi*		SC
Hurd's metapogon robberfly	*Metapogon hurdi*		SC
Antioch mutillid wasp	*Myrmosula pacifica*		SC
San Francisco lacewing	*Nothochrysa californica*		SC
vernal pool tadpole shrimp	*Lepidurus packardi*		E
yellow-banded andrenid bee	*Perdita hirticeps luteocincta*		SC
Antioch sphecid wasp	*Philanthus nasilis*		SC
callippe silverspot butterfly	*Speyeria callippe callippe*		E
California freshwater shrimp	*Syncaris pacifica*		E
Plants			
Ferris's milk-vetch	*Astragalus tener* var. *ferrisiae*		SC
Tiburon paintbrush	*Castilleja affinis* subsp. *neglecta*		E
salt marsh bird's-beak	*Cordylanthus maritimus* subsp. *maritimus*		E
hispid bird's-beak	*Cordylanthus mollis* subsp. *hispidus*		SC
recurved larkspur	*Delphinium recurvatum*		SC
Contra Costa wallflower	*Erysimum capitatum* subsp. *angustatum*		E
diamond-petaled poppy	*Eschscholzia rhombipetala*		SC
fragrant fritillary	*Fritillaria liliacea*		SC
adobe lily	*Fritillaria pluriflora*		SC
Brewer's dwarf-flax	*Hesperolinon breweri*		SC
pappose spikeweed	*Hemizonia parryi* subsp. *congdonii*		SC
Carquinez goldenbush	*Isocoma arguta*		SC
northern California black walnut	*Juglans californica* var. *hindsii*		SC
Contra Costa goldfields	*Lasthenia conjugens*		E
legenere	*Legenere limosa*		SC
little mousetail	*Myosurus minimus* subsp. *apus*		SC
Colusa grass	*Neostapfia colusana*		T
Antioch Dunes evening-primrose	*Oenothera deltoides* subsp. *howellii*	X	E
Gairdner's yampah	*Perideridia gairdneri* subsp. *gairdneri*		SC
Solano grass	*Tuctori mucronata*		E

[a] E = Endangered; T = Threatened; P = Proposed; C = Candidate; SC = Species of Concern.

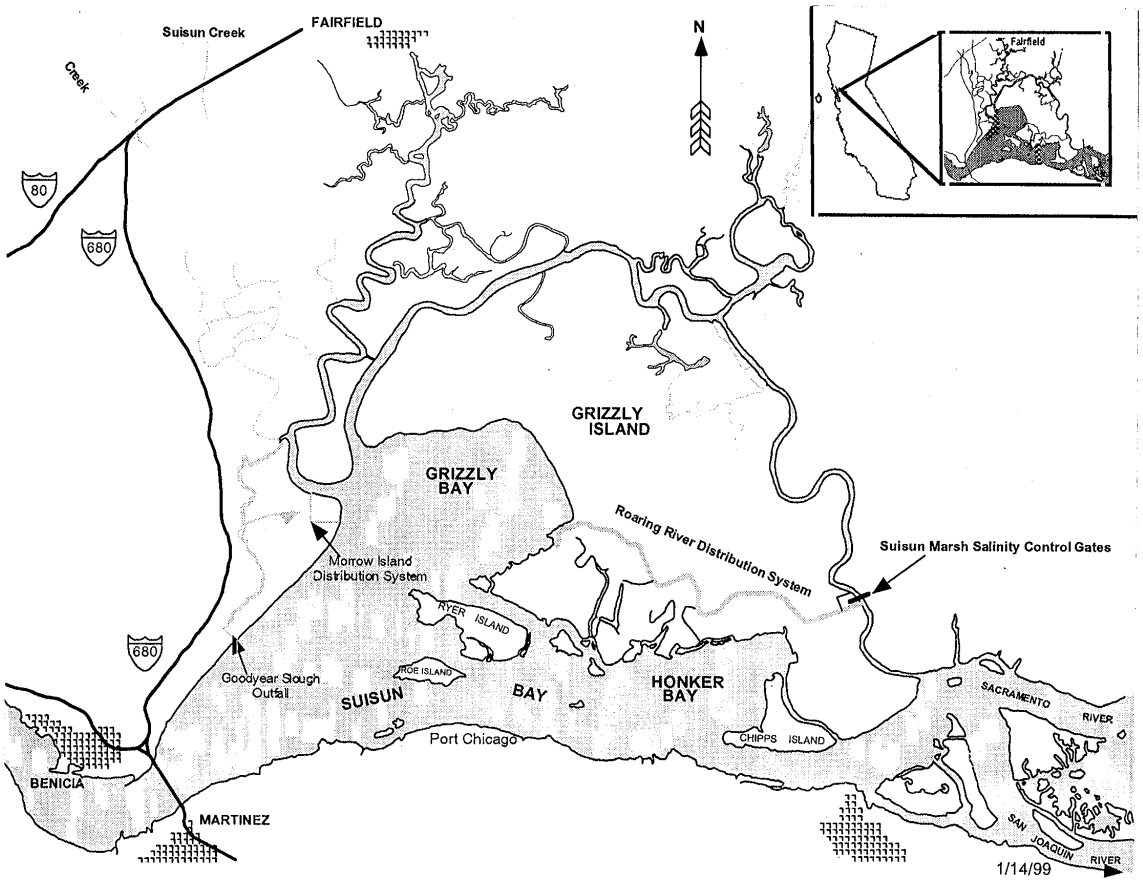

Figure 1 The Suisun Marsh

Implementation of the SMPA included (1) continued operation and maintenance of the Initial Facilities (Roaring River Distribution System, Morrow Island Distribution System, and Goodyear Slough Outfall); (2) construction of the Suisun Marsh Salinity Control Gates (SMSCG) in November 1988 and operation as needed to meet D-1485 salinity standards in the Suisun Marsh; (3) installation of the Lower Joice Island and Cygnus diversions; and (4) implementation of the Individual Ownership Cost-share Program. Under the Cost-share Program to date, DWR and USBR have funded about $1.2 million in improvements (primarily pumps and drain facilities) on individual ownerships to assist landowners in achieving the goals of their management plans. The construction of additional water conveyance facilities to provide lower salinity water throughout the Suisun Marsh were envisioned and included as subsequent phases of the SMPA and Plan of Protection.

DWR, USBR, and DFG also signed two companion agreements on 2 March 1987: the Suisun Marsh Mitigation Agreement and the Suisun Marsh Monitoring Agreement. The SMPA references these agreements and incorporates their requirements.

In 1994, the Principles of Agreement on Bay-Delta Standards between the State of California and the Federal Government was signed, initiating a process to implement a Bay-Delta protection plan through the SWRCB. Accordingly, SWRCB adopted a Water Quality Con-

trol Plan in May 1995 and Order WR 95-6 in June 1995. The current water quality control plan calls for increased water releases through the Delta greater than those called for in D-1485 (1978). Results from DWR's Suisun Marsh hydrodynamic and salinity transport modeling indicates that eastern and central marsh salinity objectives would be met on most occasions by operating the existing facilities, including the SMSCG, under the 1995 Water Quality Control Plan flows and salinities, although infrequent marginal exceedances of salinity objectives may occur in the western marsh during dry and critical water years.

The SMPA parties agree that the SMPA should be amended to reflect the effectiveness of the existing facilities and the additional outflow required by the 1995 Water Quality Control Plan. Several other factors contributed to this as well. For example, data collected from private and public managed wetlands indicate that water management plays a pivotal role in achieving soil water salinity and habitat goals (DWR 1992, 1993, 1994). Also, the original SMPA does not adequately address the effects to managed wetlands under drought conditions and a prolonged drought, such as the one from 1987 through 1992, which was not contemplated when the deficiency standards (allowing higher salinity) were included in the original agreement. Hence, the SMPA parties decided that an amendment was needed. The actions proposed in Amendment Three were developed and negotiated to address this situation.

The original SMPA does not adequately characterize the affects of SWP and CVP operations on water quality conditions in the western Suisun Marsh. DWR and USBR analyzed several years of hydrodynamic and salinity modeling and water quality data collected in the Suisun Marsh and concluded that SWP and CVP operations and other diversions upstream of Chipps Island have not significantly affected flow or water quality patterns in creeks north and west of Suisun Marsh (DWR 1994). However, urbanization and land development north and west of the marsh do significantly affect the pattern of creek inflow, sediment, and water quality entering the marsh.

Current Management Direction

In 1995, the SMPA parties agreed that the additional large-scale facilities described in the SMPA and the 1984 Plan of Protection for the Suisun Marsh (or equivalent actions) are no longer necessary for salinity control in Suisun Marsh because of the effective operation of the SMSCG, increased outflows provided under the 1994 Principles of Agreement, and the SWRCB's 1995 Water Quality Control Plan. Therefore, DWR and USBR stopped work on the environmental documentation and planning for the Western Suisun Marsh Salinity Control Project in April 1995.

In July 1995, the SMPA parties decided to amend the SMPA based on the following considerations.

- Operation of the SMSCG is very effective at lowering channel water salinity and meeting eastern and central marsh channel water salinity standards.
- SWRCB Order WR 95-6 mandated increased Delta outflow.
- A large-scale facility constructed to meet western marsh salinity standards would be very expensive.
- Significant environmental effects are associated with construction of a western marsh facility.
- Water management can be effective at maintaining optimal soil water salinity levels and plant productivity.

- Additional measures are necessary to maintain soil water salinity levels during drought periods.

The purpose of Amendment Three is to revise the SMPA to provide equivalent or better protection to Suisun Marsh managed wetlands (see Figure 1) as intended under the original agreement. Amendment Three will also make channel water salinity standards consistent with the SWRCB's 1995 Water Quality Control Plan.

Amendment Three will therefore update and replace the original agreement. Provisions included in the original SMPA and agreed to in this proposed third amendment, provide or fund facilities or activities that mitigate effects of reduced Delta outflow caused by SWP and CVP operations and other upstream diverters. Amendment Three will replace large-scale facilities described in the original agreement with water and land management actions that would assist landowners of managed wetlands in achieving soil salinities for improved growth of forage for waterfowl on managed wetlands and meet the objectives of the original agreement, which remain the same today as in 1987. These objectives are described in detail in the *Draft Environmental Assessment and Initial Study* prepared by the SMPA parties (SMPA 1998).

In the original agreement, SMPA parties agreed to limit its provisions primarily to managed wetlands. However, as part of Amendment Three, the mitigation agreement would be updated to broaden potential mitigation activities to include multi-species management and tidal marsh restoration. In addition, the undiked wetlands may be considered in other forums or agreements, such as the SWRCB water quality control planning for the Delta, CALFED, USFWS Tidal Marsh Recovery Plan, and Baylands Ecosystem Habitat Goals Project. Other legal and administrative forums addressing the Suisun Marsh are discussed in detail in the *Draft Environmental Assessment and Initial Study* (SMPA 1998).

In addition, Amendment Three incorporates channel water salinity standards in the marsh similar to those under the original agreement, and consistent with the SWRCB's terms and conditions in DWR and USBR water right permits for the SWP and CVP. At the same time, actions in Amendment Three would provide equivalent or better protection to the western marsh than the SWRCB channel water salinity objectives for stations S-35 and S-97 as described in the *Demonstration Document* (DWR 1998).

Amendment Three also requires amending and revising the Suisun Marsh Monitoring Agreement. Any monitoring required as part the Amendment Three actions would be included in the updated agreement. The SRCD will be included as a participant in the amended monitoring program. The Monitoring Agreement will be amended after Amendment Three is finalized and signed by the four SMPA parties.

Chapter 2
MITIGATION AND MONITORING

Mitigation

Mitigation proposed as part of Amendment Three includes broadening the scope of mitigation activities from the original agreement to emphasize management and restoration projects that mitigate for impacts to listed and sensitive species. To facilitate this, the last installment of the mitigation funds (over $3.2 million in 1999 dollars) associated with the original agreement shall be used for multi-species management. In addition, the SMPA Environmental Coordination Advisory Team (ECAT) was convened in April 1998 to ensure compliance with mitigation and monitoring responsibilities. USFWS and NMFS staff have been invited to participate on the ECAT, and USFWS and US Army Corps of Engineers (USACE) staff are now serving in an advisory role.

ECAT will play a significant role in implementing the amended Suisun Marsh Mitigation Agreement as part of the Amendment Three process. ECAT will also document compliance with biological opinion measures and permit terms and provide reports to the SMPA Coordinators. Further, ECAT will coordinate preconstruction inspections as specified in Amendment Three for the Wetland Management Program, Joint-use Facilities, and Portable Pumps activities. In addition, ECAT will provide guidance to the water manager, which as specified in the duties of the Water Manager Program, will advise landowners on management practices that benefit endangered species.

All Amendment Three actions were designed to comply with the mitigation requirements of the 1981 biological opinion on the Suisun Marsh Management Plan issued by the USFWS pursuant to the Endangered Species Act of 1973 (ESA). The 1981 biological opinion states that management activities in the marsh could potentially affect the federally-listed salt marsh harvest mouse, *Reithrodontomys raviventris*, and the California clapper rail, *Rallus longirostris obsoletus.*

The biological opinion identified mandatory mitigation measures to insure the protection of these listed species, including conducting systematic population surveys of the SMHM. In May 1987, DFG and USFWS developed a mitigation plan in response to the 1981 biological opinion. DFG agreed to implement the terms and conditions and develop a plan to manage seven mitigation parcels (conservation areas) totaling approximately 1,000 acres of preferred SMHM habitat on existing DFG lands in the marsh (Figure 2). The provision to manage 1,000 acres of preferred SMHM habitat was also included as a USACE permit condition to operate the SMSCG. The *Plan to Manage 1,000 Acres of DFG Lands in the Suisun Marsh for the Salt Marsh Harvest Mouse* (DFG 1987) is included in the *Draft Environmental Assessment and Initial Study* as Appendix M. To date, DFG has set aside eight parcels, including 150 acres at Peytonia Slough Ecological Reserve, for a total of 1,289 acres for the SMHM (Table 3). DFG recently conducted a Global Positioning System survey during winter 1999 to determine the actual acreage of these eight conservation areas.

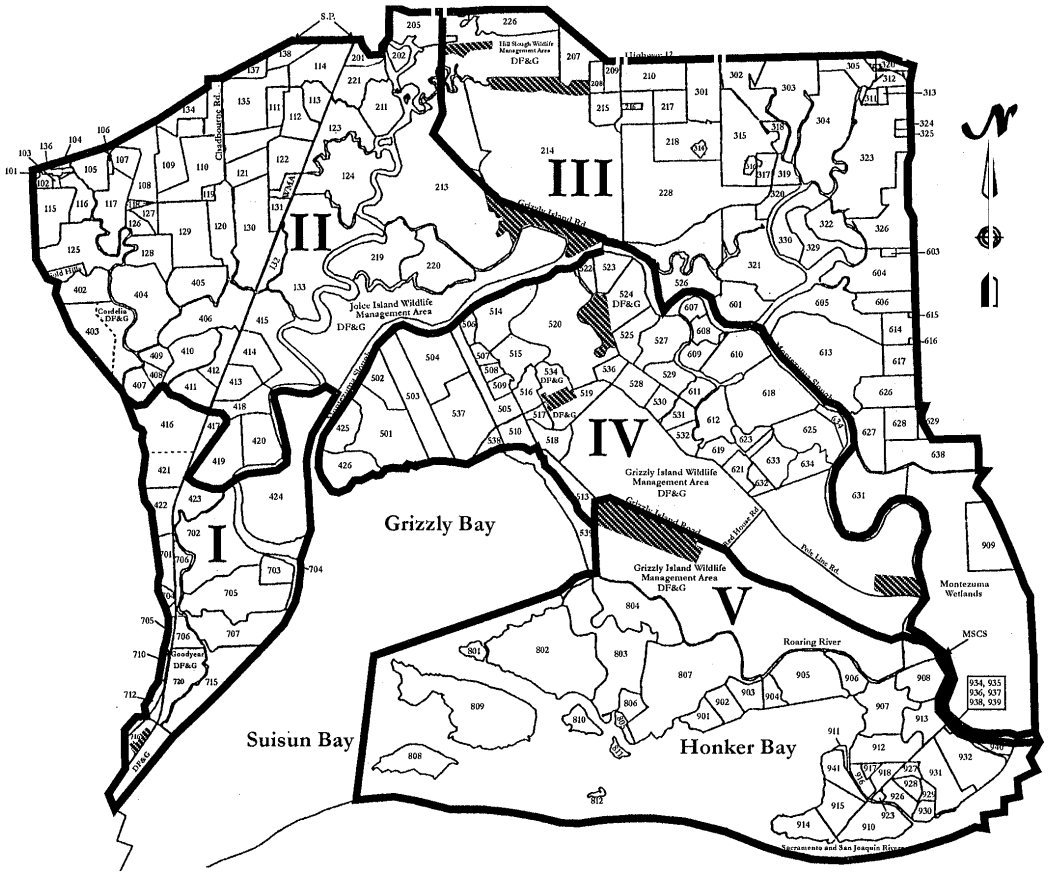

Figure 2 SRCD ownership maps showing existing conservation areas and vegetation zones

The SMPA parties acknowledged in 1998 that these mitigation requirements have not been met in their entirety and have been working with USFWS staff to meet the mitigation objectives. A letter dated 30 March 1998, addressed to USFWS Regional Director Michael Spear and signed by former DWR Director David Kennedy, DFG Director Jacqueline Schafer, and USBR Regional Director Roger Patterson, included several tables with proposed activities and timelines to meet the mitigation obligations of the 1981 and 1986 biological opinions. The USFWS responded in a letter dated 25 August 1998, providing constructive comments on how the SMPA parties and USFWS can work together to achieve the mitigation objectives. The ECAT is addressing specific action items proposed in the letter. DFG letters addressed to USFWS dated 30 April 1998 and 30 September 1998 reported on the status of action items listed in the letter to Michael Spear, dated 30 March 1998.

The locations of existing and proposed mitigation conservation areas are presented in Figure 3. Identification codes in Tables 3A, 3B, and 3C correspond to the sites identified in Figure 3. The size of each of the proposed parcels will be verified by a Geographic Information System (GIS) survey. DFG proposes to begin verification using GIS during summer 1999 and expects to provide ECAT with accurate acreage totals by November 1999.

Suisun Marsh mitigation obligations and lands currently managed to meet these obligations are presented in Table 3A and shown in Figure 3.

Table 3A Existing salt marsh harvest mouse conservation areas

	Habitat Description						*Restoration Status and Goal*		
Existing Conservation Area	*Diked*	*Muted Tidal*	*Full Tidal*	*Upland Refugia*	*Existing SMHM Habitat*	*Acres*	*Enhancement or Restoration Needed*	*Year Trapped*	*SMHM Presence*
Grizzly Island Unit									
1 Pond 1	X			Yes	Yes	101.8	No	1998 1999	Yes Yes
2 Pond 15	X			Yes	Yes	357.2	No	1998	Yes
3 Crescent Unit	X			Yes	Yes	66.6	No	1998 1999	Yes Yes
4 Joice Island			X	Yes	Yes	271	No	1998 1999	
Hill Slough Wildlife Area									
5 Hill Slough Area 8 (adjacent to the Potrero Hills)			X	Yes	Yes	123	No	1998 1999	No Yes
6 Hill Slough (west of McCoy Creek, Pond 4)				Yes	Yes	70.7	No	1998	Yes
7 Benecia Industrial Area				Yes	Yes	46.2	Yes, restore to full tidal action	1998 1999	Yes Yes
8 Peytonia Slough [a]		X		Yes	Yes	253	No	1998	Yes
Total Acreage						1289.5			

[a] Peytonia Slough was included in the Conservation Measures in the USFWS 1981 Biological Opinion as a potential SMHS conservation area. It was not included in the DFG's original list of conservation areas, but is included here.

Table 3B Proposed salt mouse harvest mouse conservation areas

	Habitat Description						*Restoration Status and Goal*		
Proposed Conservation Areas	*Diked*	*Muted Tidal*	*Full Tidal*	*Upland Refugia*	*Existing SMHM Habitat*	*Acres*	*Enhancement or Restoration Needed*	*Year Trapped*	*SMHM Presence*
Grizzly Island Unit									
A Between Grizzly Island Road and Pond 11and Between Red House Road and Pond 11 (formerly two areas A and B)	X			Yes	Yes	184	No	1999	Yes
C Pond 12F	X			Yes	Yes	114	No	1999	Yes
D Between Grizzly Island Road and Pond 12	X			Yes	Yes	27	No	1999	Yes
Hill Slough Wildlife Area west of McCoy Creek									
E Ponds 1 and 2 west of Grizzly Island Road	X			Yes	Yes	204	Yes, restore to full tidal action	1999	Yes
F East of Grizzly Island Road north of the access road	X			Yes	Yes	87	No	1999	Yes
G Hill Slough Wildlife Area east of McCoy Creek			X	Yes	Yes	527	No	1999	Yes
Benicia Industrial Area									
H Goodyear Slough Unit South of Lake Herman Road	X			Yes	Yes	280	Yes, restore 245 acres of 305 acres to tidal action: 60 acres are currently for mitigation	1999	Yes
Total Acreage						1423			

Table 3C Other mitigation acreage in Suisun Marsh

Additional SMHM Mitigation Obligations	*Mitigation Obligation*	*Description*	*Acres* [a]	*Enhancement or Restoration Needed*	*SMHM Presence*
I Island Slough	Mitigation for Plan of Protection and SMPA facilities	Diked managed wetland	100	Yes, restore SMHM habitat	1999
J Morrow Island Distribution System	Mitigation for filing 19 acres of wetlands	Diked managed wetland at Island Slough	57	Yes, restore SMHM habitat	NT [b]
K Van Sickle Island	Dredge spoils from the SMSCG	Diked managed wetland	12.5	No	NT [b]
L Goodyear Slough Unit, south of Lake Herman Road	Mitigation for the Maritime Administration roadway	Tidal wetland	60	No	NT [b]
Total Acreage			229.5		

[a] All acreages subject to GIS verification.
[b] Not trapped, no trapping effort took place.

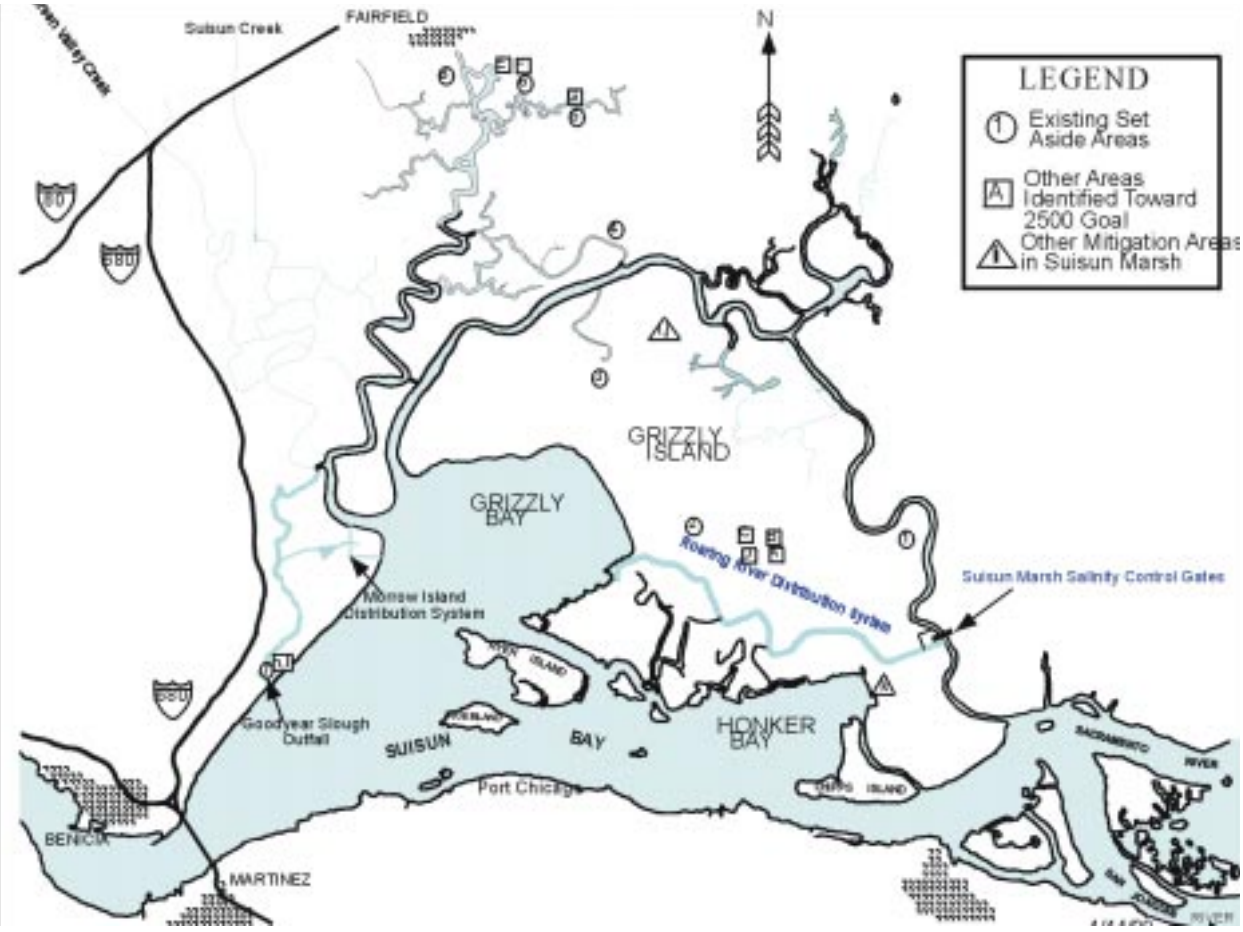

Figure 3 Existing and proposed mitigation sites in the Suisun Marsh

In addition, Table 3B identifies DFG-owned lands in Suisun Marsh which could be set aside and managed to achieve the 2,500-acre goal for preferred SMHM habitat, as described in the 1981 biological opinion. Table 3B expands on Attachment 1 of the status report (dated 30 September 1998 and addressed to USFWS) by describing the acreage, type of proposed restoration, and presence of SMHM.

Table 3B identifies an estimated 1,423 acres of wetlands that have been proposed to be set aside and managed for potential preferred SMHM habitat on DFG-owned lands in the marsh. Of the new areas described in Table 3B, DFG has identified 484 acres that may be suitable for conversion to tidal wetlands. Included in these 1,423 acres is also a 280-acre parcel that DFG and CalTrans have jointly proposed to restore to full tidal action (see Figure 3). This DFG-owned 280-acre parcel is currently a muted tidal wetland.

Table 3C identifies 229.5 acres of additional mitigation obligations that DWR and USBR have related to SMHM habitat. The obligation for the 57 acres for Morrow Island Distribution System dredging is being met by developing an additional 57 acres at Island Slough. ECAT agreed to this location at its March 1999 meeting and DFG is preparing a monitoring plan. The installation of water control facilities is scheduled for summer 1999.

The SMPA parties would prepare actions for management and monitoring, including a reasonable and appropriate timeline. Acreage would be managed to provide high-quality SMHM habitat based on habitat criteria being established for the 1,125 acres included in the existing conservation areas.

DWR and USBR have identified approximately $3,436,000 that could be used to meet the 57-acre mitigation obligation for Morrow Island Distribution System dredging (letter J in Table 3C), and restore other areas in the marsh.

The acreage converted to tidal wetlands, including the DFG-CalTrans project, would be used to meet the 2,500-acre goal described in the 1981 biological opinion. The total acreage proposed for management of preferred salt marsh habitat or tidal wetland restoration totals **2,567.5** acres, including the 229.5 acres of additional mitigation obligations in Suisun Marsh (see Tables 3A, 3B, and 3C). Also, the SMPA parties will continue to pursue opportunities within the Suisun Marsh to acquire and manage additional SMHM habitat acreage.

Monitoring

SMPA monitoring efforts are briefly described below. The current Suisun Marsh monitoring efforts are presented in detail in the *Suisun Marsh Monitoring Program Data Summary Report Reference Guide* (DWR forthcoming).

Salt Marsh Harvest Mouse Monitoring

In June 1999, the ECAT approved a revised DFG survey protocol for the SMHM in the Suisun Marsh. ECAT originally approved the SMHM survey protocol in May 1998. The objectives of the protocol are to (1) monitor SMHM population and habitat variability over time; (2) determine whether the SMHM is present on existing and proposed conservation areas; (3) evaluate habitat use to better understand the habitat mosaic (pickleweed, upland refugia, and so on) associated with SMHM; and (4) use the information gathered to guide management practices to maintain or develop SMHM habitat.

Monitoring to address the second objective began in August 1998. One hundred live traps were set in areas of best available habitat at each of the seven existing conservation areas for three consecutive nights. In addition, vegetation in each trapping grid was also surveyed.

All plant species along randomly placed five-meter transects were recorded. Presence and absence surveys at the proposed conservation areas were also conducted during 1999.

Once SMHM presence has been established, future trapping will be tailored toward monitoring and research needs, such as determining what areas are used as refugia, if and when the SMHM uses suboptimal habitats, population dynamics in relation to flood levels, competition and interactions with other rodent species, and which areas of the marsh support self-sustaining populations. Mark-recapture protocols will determine population sizes in different habitat types and in the different conservation areas.

Vegetation Monitoring

Conservation measures outlined in the 1981 biological opinion required that vegetation monitoring be conducted in the marsh. A monitoring plan was developed to assess the overall vegetative composition of the marsh utilizing color aerial photography in conjunction with ground verification every third year. Surveys were conducted in 1981, 1988, 1991, and 1994. The results were to be compared to the results from previous flights and reported in acres and percent of total vegetation for each major plant species.

In addition to monitoring vegetation change across the marsh, the Triennial Survey was designed to monitor the acreage of appropriate SMHM habitat. For this purpose, the marsh was divided into five zones to decrease the potential for significant local decreases in habitat being masked by increases in other areas of the marsh. These zones (see Figure 2) were established prior to the 1981 survey, and were used to analyze vegetation changes in each subsequent survey.

Although the aerial surveys were conducted, the aerial photo interpretation and annual vegetation monitoring were not finalized and approved. The five zones established in the marsh have not been used for their original purpose of assessing changes in appropriate SMHM habitat. The regulatory agencies had concerns about the methodology used and the lack of useful maps from the 1988, 1991, and 1994 surveys. Determination of marshwide, individual species composition would require an extremely intensive sampling effort with rigorous replication. Marsh habitats are mixed assemblages of several species rather than monotypic stands. To lump percentages of species within each habitat into single species categories loses the character of the actual habitat.

A new vegetation survey protocol was implemented in 1999 under the direction of Dr. Todd Keeler-Wolf at DFG. This survey methodology is designed to meet the goal of documenting changes in appropriate habitat for the SMHM, as well as gather vegetation data useful for a variety of other purposes, including correlating management activities with vegetation changes, supporting a GIS application to permit spacial analysis incorporating other types of data and creating a base map for future studies.

The vegetation mapping methodology to be used reflects the protocol in “Field Methods for Vegetation Mapping” supported by the National Park Service and Biological Resources Division of the US Geological Survey (USGS 1997a). The value of this approach is a precise vegetation map with detailed classifications of vegetation. The specific methods of this monitoring plan are described in *The Survey for the Suisun Marsh Proposal for a New Methodology* (DFG 1998). This plan was approved by ECAT in May 1999.

Fisheries Monitoring

Before installation of the SMSCG, DWR and USBR were required by a USACE permit to

conduct a pre-project fishery resource evaluation to provide baseline information on the fish in Montezuma Slough (Spaar 1988). This information also allowed researchers to develop a monitoring program for the marsh, which includes elements for specific species and life stages, fish predation losses, and relative fish abundance. These elements are reviewed annually by the USFWS, NMFS, DWR, and DFG to determine if these studies adequately address permit requirements.

DFG and DWR conducted adult salmon migration studies in water year 1993 through water year 1995 to determine if the SMSCG has an effect on adult salmon migration through Montezuma Slough. As a result of these studies, the flashboards on the SMSCG were modified in 1998 to include two, three-foot horizontal openings to allow fish passage. A three-year study evaluating how these openings affect salmon migration began in fall 1998.

In addition to DFG efforts and other fisheries sampling efforts in the marsh, the University of California at Davis (UC Davis) has conducted a monitoring program since 1979. A comprehensive report detailing the fisheries monitoring program in Suisun Marsh is prepared and distributed annually.

Water Quality Monitoring

Five compliance stations in the marsh (C-2, S-42, S-64, S-49, and S-21) collect specific conductance and tide stage data mandated by D-1485, Order WR 95-6, and Order WR 98-9 by SWRCB. Thirteen other monitoring stations throughout the marsh collect similar data (Figure 4). Tide stage and specific conductance data are monitored at 15-minute intervals and data are telemetered to the California Data Exchange Center in Sacramento. A report is prepared and distributed annually.

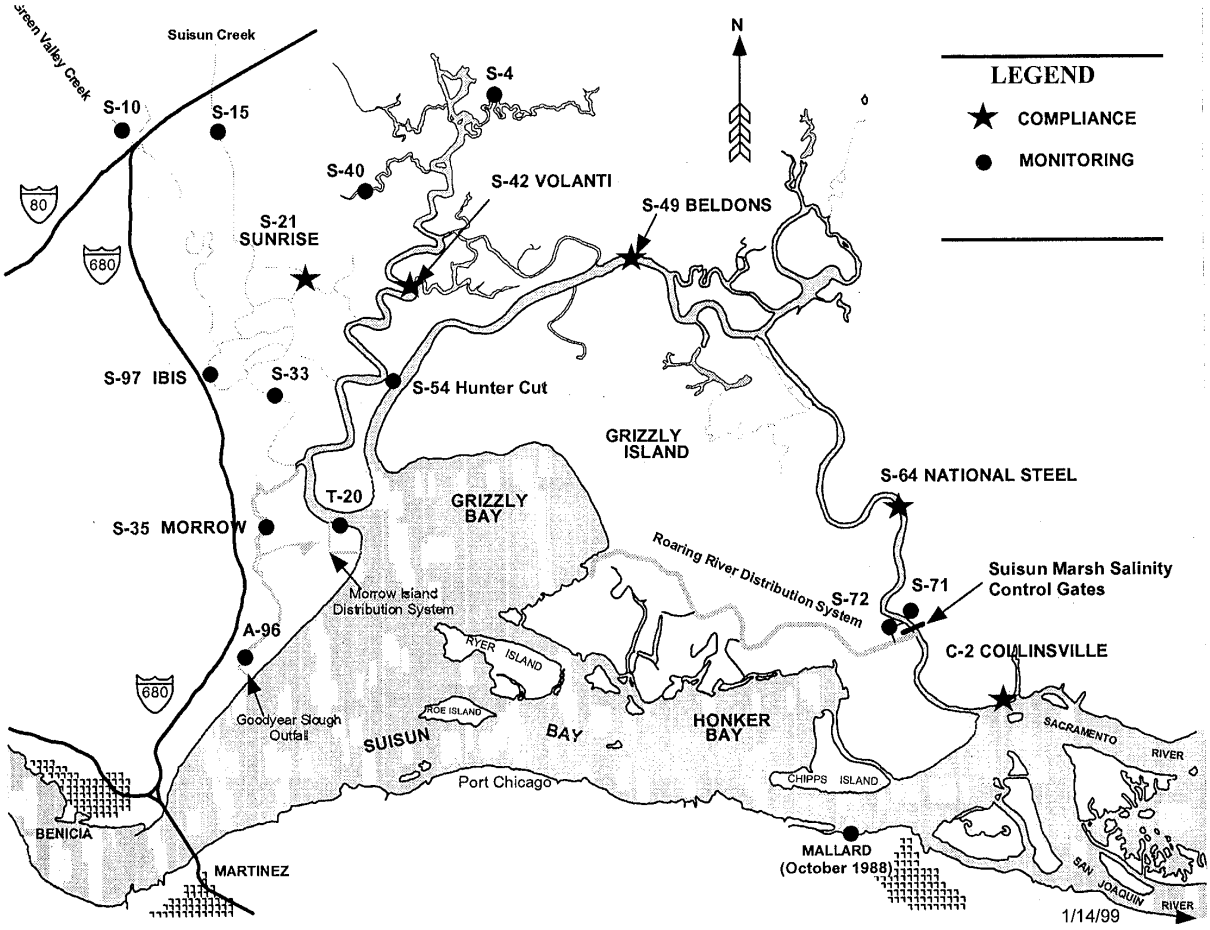

Figure 4 Suisun Marsh compliance and monitoring stations

Chapter 3
PROJECT AREA AND EXISTING ACTIVITIES

Suisun Marsh (see Figure 1), about 35 miles northeast of San Francisco in southern Solano County, provides habitat for numerous species of plants, fish, and wildlife. This tidally influenced brackish marsh is a vital wintering and nesting area for waterfowl of the Pacific Flyway, and is the largest contiguous estuarine marsh remaining in the United States. The State of California recognized the biological importance of the marsh and passed a series of laws and regulations designed to stop urban encroachment, preserve Suisun Marsh habitat, maintain an adequate water supply with suitable water quality, and protect lands within the Suisun Marsh.

In 1963, the local landowners formed the Suisun Soil Conservation District (SSCD). In 1977, after the passage of AB 1717, the Suisun Resource Conservation District (SRCD) was formed from the SSCD. SRCD includes 116,000 acres of managed and tidal wetlands, uplands, bays and sloughs. The boundaries of SRCD include Interstate 680 on the west, Cordelia Road and Highway 12 to the north and east and the Solano-Contra Costa County line in Suisun Bay.

Diked Wetland Management

Managed wetlands in Suisun Marsh include about 37,500 acres in 158 private ownerships and about 15,300 acres of State-owned land managed by DFG. The diked, seasonal wetlands are managed primarily for waterfowl but are used by other marsh wildlife. Most wetland managers in the Suisun Marsh begin flooding their properties on 1 October in preparation for the fall waterfowl migration. Some wetland managers, including DFG, begin flooding in September with permission from the Solano County Mosquito Abatement District. After the initial flood-up, most wetland managers circulate water in the ponds during the waterfowl hunting season. Except for the permanent ponds, the diked wetlands are drained between January and mid-June to allow vegetative growth and to perform necessary routine maintenance activities during the summer. A complete description of managed wetland operations can be found in Chapter 2 of the *Draft Environmental Assessment and Initial Study* (SMPA 1998).

Wetland managers in the Suisun Marsh conduct ongoing land management and maintenance to sustain and improve waterfowl food plant productivity. Maintenance activities on privately managed wetlands and DFG lands are authorized under the USACE Regional General Permit (RGP) Number R20066E98, issued in March 1995 to SRCD. The permit set limitations on the type and extent of work (including grading, circulation ditch maintenance, and installation of water control structures and pumps) for each public and private ownership in Suisun Marsh. RGP limitations are associated with the acreage of each property in the marsh. A detailed description of RGP R20066E98 and its limitations is found in chapter 2 of the *Draft Environmental Assessment and Initial Study* (SMPA 1998).

SRCD and DFG are currently in the process of renewing the RGP authorizing the same work as the current permit. The activities described in Amendment Three would be carried out in accordance with the conditions of the new permit.

SWRCB 1995 Water Quality Control Plan, Order WR 95-6, and Order WR 98-9

The 1994 Principles of Agreement on the Bay-Delta was signed, initiating a process to implement a Bay-Delta protection plan through the SWRCB. Accordingly, SWRCB adopted the 1995 Water Quality Control Plan and Order WR 95-6 that called for increased water releases through the Delta greater than called for in D-1485 (1978). The SWRCB issued Order WR 98-9 in 1998, which extended the provisions of Order WR 95-6 through December 1999.

Increased flows have resulted in lower channel water salinity in much of the Suisun Marsh. DWR's Suisun Marsh modeling studies indicate that eastern and central marsh salinity objectives would be met on most occasions under current flow conditions by operating existing facilities, including the SMSCG.

DWR and USBR Facilities in the Suisun Marsh

Several facilities have been constructed by DWR and USBR and operate in the Suisun Marsh. These facilities (see Figure 1) are identified in the *Plan of Protection for the Suisun Marsh including the Environmental Impact Report* and the 1987 SMPA. The purpose of these facilities is to provide lower salinity water to managed wetlands. The Initial Facilities, including the Roaring River Distribution System, Morrow Island Distribution System, and Goodyear Slough Outfall, were constructed in 1979 and 1980. The SMSCG were installed and became operational in 1988. The existing facilities are described in detail below. Other facilities constructed under the SMPA include the Cygnus drain and the Lower Joice Island diversion and drain. Several additional large-scale facilities are identified in both the Plan of Protection for the Suisun Marsh and the original SMPA and were to be phased in for salinity control in the marsh.

Suisun Marsh Salinity Control Gates

The SMSCG are located about two miles northwest of the eastern end of Montezuma Slough, near Collinsville. The SMSCG span Montezuma Slough, a width of 465 feet. In addition to permanent barriers adjacent to each levee, the structure consists of the following components (from west to east): (1) a flashboard module, which provides a 66-foot wide maintenance channel through the structure (the flashboards can be removed if emergency work is required, but removal requires a large, barge-mounted crane); (2) a radial gate module, 159 feet across, containing three radial gates, each 36 feet wide; and (3) a boat lock module, 20 feet across, which is operated when the flashboards are in place. An acoustic velocity meter is located about 300 feet upstream (south) of the gates to measure water velocity in Montezuma Slough. Water level recorders on both sides of the structure allow operators to determine the difference in water level on both sides of the gates. The three radial gates open and close automatically, using the water level and velocity data.

Operation of the SMSCG began in November 1988. The facility was implemented in Phase II of the *Plan of Protection for the Suisun Marsh*. The primary objective is to tidally pump lower salinity water from Collinsville through Montezuma Slough into the eastern and central marsh and retard the movement of higher salinity Grizzly Bay water into the western marsh. Operating the SMSCG is essential for meeting Order WR 98-9 and SMPA standards in the eastern and central marsh, and lowering salinity in the western marsh.

Operation of the SMSCG retards the upstream flow of higher salinity water from Suisun Bay during flood tides, while allowing the normal flow of lower salinity water from the Sacramento River during ebb tides. During full operation, the gates open and close twice each

tidal day with the tides. Flows past the gates vary from upstream flow through the horizontal slots in the modified flashboards when the gates are closed to several thousand cubic feet per second in the downstream direction with all three gates open. The net flow through the gates is about 1,800 cfs in the downstream direction when averaged over one tidal day. In summer, when the gates are typically not operating and the flashboards are removed, the natural net flow in Montezuma Slough is low and often in the upstream direction from Grizzly Bay toward Collinsville.

A three-year study to evaluate whether a modified flashboard system could reduce the delay in adult salmon migration was initiated in September 1998. For this study, the flashboards were modified creating horizontal slots to allow fish passage during gate operation. The first field season (in other words, fish tagging and tracking) was conducted during September, October, and November 1998. A second field season is currently underway. Salinity is also monitored during the evaluation to determine if SWRCB salinity standards can be met with the modified flashboards in place.

SMSCG Operation and Stop Operation Criteria. The SMSCG have been and could be operated from 1 September through 31 May, but only as needed to meet SWRCB and SMPA standards in October through May. Since 1988, the SMSCG have been operated in September during four years (1989, 1990, 1993, and 1994), either for testing the effectiveness of gate operations or to help reduce channel salinity for initial flooding of managed wetlands during drought conditions.

The non-operation configuration of the SMSCG consists of the removal of the flashboards (maintenance channel open), the three radial gates held open, and the boat lock closed. The SMSCG are in this configuration (1) from 1 June through 31 August of all years; (2) from 1 September until SMSCG operation is initiated for the first time in a control season; and (3) once operating, from the day that SMSCG operation is no longer needed to meet standards through the remainder of the control season ending on 31 May.

The flashboards are installed and radial gate operations are initiated in a control season as follows.

- In September, if high tide channel water salinity is above 17 mS/cm at any trigger station (2 mS/cm below the October standard). Trigger stations are S-35, S-42, S-49, and S-64.

- From 1 October through 31 May, if two consecutive high tide salinities are within 2 mS/cm below the current and subsequent months' standards at any trigger station.

Once the flashboards are installed, operations are stopped as follows.

- Radial gate operation is stopped (held open) when two consecutive high tide salinities are below 2 mS/cm of the current and subsequent months' standards at all trigger stations.

- Flashboards are removed if it is determined that salinity conditions at all trigger stations would remain below standards for the remainder of the control season through 31 May.

Morrow Island Distribution System

The Morrow Island Distribution System (see Figure 1) was constructed in 1979 and 1980 as part of the Initial Facilities to provide water to private managed wetlands on Morrow Island and to channel drainage water from the adjacent managed wetlands for discharge into Grizzly Bay rather than Goodyear Slough. The

distribution system is used primarily during the control season. When managed wetlands are filling, water is tidally pumped from Goodyear Slough just south of Pierce Harbor through three 48-inch culverts. Drainage water from Morrow Island is discharged into Grizzly Bay by way of the C-line outfall and into the mouth of Suisun Slough by way of the M-line outfall, rather than back into Goodyear Slough. This helps prevent increases in salinity due to drainage water discharges into Goodyear Slough.

DWR and USBR will construct, operate, and maintain a fish screen on the intake of the Morrow Island Distribution System to reduce the number of fish diverted into the system. DWR and USBR are required to install a fish screen on the intake as a condition of the April 1997 biological opinion issued by USFWS as part of the USACE permit for maintenance dredging of the Morrow Island Distribution System. DWR and USBR performed maintenance dredging during summer 1997 and restored the levee roads during summer 1998 as a requirement under the original SMPA. DWR prepared separate environmental documentation for the dredging project. The mitigation obligation for this project included establishing 57 acres of preferred pickleweed habitat. Approved to fulfill this mitigation obligation, an additional 57 acres at Island Slough will be managed for pickleweed.

Roaring River Distribution System

The Roaring River Distribution System (RRDS) (see Figure 1) was constructed as part of the Initial Facilities in 1979 and 1980. The system was constructed to provide lower salinity water to 5,000 acres of both public and privately managed wetlands on Grizzly, Simmons, Hammond, Van Sickle, and Wheeler islands. Construction involved enlarging Roaring River Slough and extending its western end. Excavated material was used to widen and strengthen the levees on both sides of the system.

The RRDS includes a 40-acre intake pond, constructed west of the new intake culverts, that supplies water to Roaring River Slough. Flows through the culverts into the pond are controlled by motorized slide gates on the Montezuma Slough side and flap gates on the pond side. A manually operated flap gate and flashboard riser is located at the confluence of Roaring River and Montezuma sloughs to allow drainage back into Montezuma Slough for controlling water levees on the distribution system and for flood protection. DWR owns and operates this drain gate to ensure that the Roaring River levees are not compromised during extremely high tides.

Water is diverted through a bank of eight 60-inch diameter culverts into the Roaring River intake pond on high tides to raise the water surface elevation in RRDS above the adjacent managed wetlands. Managed wetlands north and south of the RRDS receive water as needed through DFG-owned and privately owned turnouts on the system.

The intake to RRDS is screened to prevent entrainment of fish larger than approximately 25 mm. DWR designed and installed the screens using DFG criteria. The screen is a stationary vertical screen, constructed of continuous-slot, stainless steel wedge wire. All screens have 3/32-inch slot openings. Since the listing of delta smelt, RRDS diversion rates have been automatically controlled to maintain an average approach velocity below 0.2 ft/s at the intake fish screen. Initially, the intake culverts were held at about 20% capacity to meet the velocity criterion at high tide. Since 1996, the motorized slide gates have been operated remotely to allow hourly adjustment of gate openings to maximize diversion throughout the tide.

During the 1998 floods, portions of the levees along the RRDS sustained significant damage. The levees were repaired during August and September 1998 using approximately 8,000 cubic yards of imported fill material and 2,000 yards of aggregate base. In addition, approximately 200 cubic yards of 12-inch minus riprap was replaced on the waterside of the levee for erosion protection.

RRDS, like other levees in the marsh, has experienced subsidence since the levees were constructed in 1980. During 1999 DWR restored all 16 miles of levee to its original design elevation.

Routine maintenance of the system primarily consists of maintaining the levee roads. DWR provides routine screen maintenance.

Goodyear Slough Outfall

The Goodyear Slough Outfall (see Figure 1) was constructed in 1979 and 1980 as part of the Initial Facilities. A channel approximately 69 feet wide was dredged from the south end of Goodyear Slough to Suisun Bay (about 2,800 feet). The excavated material was used for levee construction. The control structure consists of four 48-inch culverts with flap gates on the bay side and vertical slide gates on the slough side. The system was designed to increase circulation and reduce salinity in Goodyear Slough by draining water from the lower end of Goodyear Slough into Suisun Bay. The system also provides lower salinity water to the wetland managers who flood their ponds with Goodyear Slough water.

Lower Joice Island Unit

The Lower Joice Island Unit (see Figure 1) consists of two 36-inch diameter intake culverts on Montezuma Slough near Hunter Cut and two 36-inch diameter culverts on Suisun Slough, also near Hunter Cut. Both sets of culverts were called for in the original SMPA and installed in the existing levee in 1991. The facilities include combination gates on the slough side and flap gates on the landward side. The Lower Joice Island facility allows more rapid filling of the site and is connected to the existing distribution system on Individual Ownership Number 424. This facility enables the individual ownership to properly manage its wetlands on Lower Joice Island.

Construction of the facility on Lower Joice Island was authorized under SRCD's RGP 9605-98D (the predecessor to its existing RGP issued by USACE in November 1987). Under the original SMPA, DWR was responsible for constructing the Lower Joice Island Unit and the individual ownership had the responsibility for operation and maintenance.

In 1997 DWR contracted with SRCD to construct a fish screen on the diversion on Montezuma Slough. This fish screen was completed and has been operating since 1998.

Cygnus Unit

The Cygnus Unit (see Figure 1) includes the installation of a 36-inch drain gate with flashboard riser on Individual Ownership Number 415. Installation of this drain gate was authorized under SRCD's RGP 9605-98D and installed in 1991. The individual landowner is responsible for operation and maintenance of this gate.

Chapter 4
PROJECT DESCRIPTION

Amendment Three Actions

Amendment Three consists of several supplemental actions which replace the large-scale facilities proposed in the original SMPA to meet channel water salinity criteria and maintain soil water salinity on managed wetlands, especially in the western marsh.

A detailed description of Amendment Three actions and potential environmental effects can be found in the *Draft Environmental Assessment and Initial Study* prepared for Amendment Three to the SMPA (SMPA 1998).

The specific actions in Amendment Three include the following.

- Making channel water salinity standards consistent with the 1995 Water Quality Control Plan and Order WR 98-9.
- Converting S-35 and S-97 from compliance stations to monitoring stations.
- Establishing a Managed Wetlands Improvement Fund.
- Establishing a Drought Response Fund.
- Establishing criteria for operating the SMSCG in September, and operate and maintain existing facilities.
- Funding updates to the Individual Ownership Management Plans.
- Funding a Water Manager Program.
- Funding a Joint-use Facilities Program.
- Funding a Portable Pumps Program for diversions and drainage.

In addition, Article VI of the SMPA would be amended to broaden mitigation activities to emphasize multi-species management and restoration projects which would mitigate for effects to listed and sensitive species. Further, the last installment of the SMPA mitigation funds (approximately $3.2 million in 1999 dollars) associated with the original agreement would be allocated for multi-species management. Also, the Suisun Marsh Mitigation Agreement, signed in 1987, will be amended and will include the SMPA Environmental Coordination Advisory Team to ensure compliance with mitigation and monitoring responsibilities.

Timeline

The implementation schedule for Amendment Three actions would be specific to each of the actions. The actions that require construction and modification within wetland areas would be conducted during the Suisun Marsh construction season, taking into account restrictions described in the SRCD's RGP. Other actions could be implemented immediately, including establishing the Water Manager Program, updating management plans, modifying the standards so that they are consistent with Order WR 98-9, and changing S-97 and S-35 from compliance to monitoring stations.

Making Channel Water Salinity Standards Consistent with the 1995 Water Quality Control Plan

Channel water salinity standards are intended to ensure that desired waterfowl forage and

habitat is maintained throughout the managed wetlands in Suisun Marsh. The channel water salinity standards in Amendment Three are those required under the 1995 Water Quality Control Plan and Order WR 98-9. A detailed summary of marsh regulatory requirements and contract obligations pertaining to marsh standards is presented in Chapter 1 of the *Draft Environmental Assessment and Initial Study* (SMPA 1998), and is the basis for the finding that proposed Amendment Three channel water salinity standards are not significantly different than existing standards and will not change or affect the existing environment.

Since 1978, Suisun Marsh channel water salinity has been controlled by regulatory requirements and contractual obligations to mitigate effects attributed to decreased Delta outflow resulting from operations of the SWP and CVP, and other upstream diversions. Through either SWRCB regulatory mandates or SMPA contract provisions, DWR and USBR have been required to maintain specific Delta outflows or salinities to protect managed wetlands.

Amendment Three differs from Orders WR 95-6 and 98-9 by proposing to convert S-97 and S-35 compliance stations to monitoring stations and by establishing other provisions for eastern marsh standards during unusually dry conditions. Amendment Three and Orders WR 95-6 and 98-9 also differ from the original SMPA in the following ways: (1) they adopt a 1.0 mS/cm lower numerical standard value for November (from 16.5 to 15.5 mS/cm) in the eastern marsh; and (2) they do not adopt deficiency standards in the eastern marsh during dry periods. Amendment Three, Order WR 98-9, and the original SMPA all adopt the same channel water salinity standards at S-21 and S-42 in the western marsh.

Amendment Three salinity standards (Table 3 of the *Draft Environmental Assessment and Initial Study*) are the same as Order WR 98-9 standards except that they eliminate S-97 and S-35 as compliance stations, and they add Article III C. Article III C recognizes that in extremely dry periods, operating the SMSCG may not always effectively control channel salinity in the eastern marsh. These provisions include waiving salinity standards, triggering the Drought Response Fund if eastern marsh salinity standards are exceeded two or more times in one year, or renegotiating Amendment Three if eastern marsh standards are exceeded more frequently.

There are no physical modifications required to implement this action. This action could be implemented immediately once the SMPA parties finalize Amendment Three.

Changing S-35 and S-97 to Monitoring Stations

A network of channel water monitoring stations is located throughout the marsh (Figure 4). The stations were originally part of the USBR monitoring network and were taken over and maintained by DWR when compliance monitoring was required as part of D-1485.

Amendment Three proposes converting compliance stations S-35 and S-97 to monitoring stations because operating the SMSCG does not directly control channel water salinity at S-97 and has only limited influence at S-35. These stations are primarily influenced by local conditions, especially runoff from the watershed north of the area. The stations would continue to monitor salinity in the area, providing information on channel water conditions. This would be used to determine whether additional management actions should be funded. See also the discussions of the Drought Response Fund and in the *Draft Environmental Assessment and Initial Study* (SMPA 1998).

Under Article V of Amendment Three, western marsh stations S-35 and S-97 would no longer be compliance stations, but would be used to determine when Drought Response Funding should begin as provided in Article VII B of Amendment Three. Salinity monitoring at S-35 would also be used to determine if the SMSCG should begin operating in September or any other month during the October through May control season.

DWR hydrodynamic modeling has determined that compliance with SWRCB standards could not be met at these stations without the construction of large-scale facilities.

DWR and USBR would continue to operate existing marsh facilities, to the extent feasible, to achieve similar channel water salinity at these stations as required at the compliance stations and to minimize effects to the managed wetlands from changing S-35 and S-97 to monitoring stations. Also, funding would be provided through the Drought Response Fund to western marsh landowners for management actions to maintain natural soil water salinities and existing plant communities to pre-drought conditions.

No physical modifications are required to implement this action. This action could be implemented immediately once the SMPA parties finalize Amendment Three.

The SMPA parties have also recommended that the SWRCB change these stations from compliance to monitoring stations as part of implementing the 1995 Bay-Delta Plan.

Managed Wetland Improvement Fund

Article VII B of Amendment Three provides funds for two cost-share programs for improvements on individual ownerships. Available funds will include the balance from the existing 75/25 Cost-share Program remaining when the amendment is signed, plus an additional $2 million (1997 dollars), which will not be adjusted for inflation. The type of improvement determines whether it would fall under the 75/25 or the 50/50 Cost-share Program.

75/25 Cost-share Program

The 75/25 Cost-share Program is an existing program that provides funds to individual ownerships to improve discharge facilities and enable landowners to flood and drain within the 30-day period as recommended in their management plans. Since 1987, DWR and USBR have paid about $1.2 million to reimburse landowners 75% of the cost to improve drainage of managed wetlands.

Reimbursement is limited to the purchase and installation of new, larger, lowered, or relocated discharge facilities (discharge gates, culverts, flashboard risers, and pumps) to enable the individual ownership to implement the 30-day flood and drain cycle. Only actions identified as “needed improvements” in the management plans are eligible for reimbursement. Funds made available by this program would not be used for maintenance or for fish screens.

Under SRCD’s RGP, activities proposed for the upcoming construction season under the 75/25 Cost-share Program would be submitted to USACE in SRCD’s annual Compliance Report.

Discharge culverts are typically 24-, 36-, or 48-inch diameter pipes, of either corrugated metal or polyvinylchloride. The drainage structure may consist of a flashboard riser on the interior (pond) side and a flap or a combination slide and flap gate on the exterior side. The new discharge structures are typically placed in the same location as the existing drainage structure. Typically, improvements would involve increasing the pipe diameter and lowering the pipe to improve drainage,

according to needed improvements specified in the management plans.

An existing drainage structure is usually replaced during low tide. A trench is excavated over the pipe, the old pipe is removed and replaced with a new pipe, and the trench is backfilled. The gates are attached to the pipe before installation.

Before culverts are repaired or replaced, field surveys would be conducted by a DFG biologist to verify that sensitive species are not in the project area. SRCD and DFG would prepare a confirmation letter and include it in the application package for reimbursement by DWR and USBR.

SRCD would verify that the work was conducted and satisfactory. All construction would be conducted during the Suisun Marsh construction season as defined by the USACE RGP and San Francisco Bay Conservation and Development Commission (BCDC) maintenance permit. All work would be done according to the special conditions defined in the permits.

50/50 Cost-share Program

A new 50/50 Cost-share Program would help landowners improve the leaching and draining efficiency of individual ownerships and also help them manage properties according to recommendations described in their Individual Ownership Management Plans.

The USBR and DWR would fund (through reimbursement) individual ownerships 50% of the cost of the following.

- Electricity and fuel for portable and stationary diversion and drainage pumps.
- Electricity for fish screen operation costs.
- Cleaning, widening, and deepening the primary and secondary ditch systems to convey drainage water to stationary and portable drain pumps and drainage structures required to meet the 30-day flood and drain cycles. (The pond bottom V-ditches and secondary ditches drain to the primary ditch, which services the drainage structure or pump.)
- Adding spreader ditches from pond bottom sinks and large poorly drained areas to primary and secondary drainage ditches.
- Raising pond bottom sinks.
- Coring interior levees.

Primary ditch systems are typically 4 to 4.5 feet deep, 12 to 20 feet wide, with a 2:1 side slope. Secondary ditch systems are typically 3 to 3.5 feet deep, 6 to 10 feet wide, with a 2:1 side slope. Excavation is typically done with an excavator, but a dragline may also be used. Spreader (or V) ditches are constructed using a V-ditch plow and are 18 to 24 inches wide and 18 to 24 inches deep, depending on the plow. Spreader ditches are used to improve leaching efficiency by draining low areas to the primary and secondary ditch system.

Excavated spoil from cleaning interior ditch systems is typically placed on the crown of an adjacent interior levee. If there are no adjacent interior levees, the material may be exported by truck and placed on the crown of exterior levees, or placed in low pond bottom sinks to raise pond bottom elevation.

The purpose of raising pond bottom sinks is to prevent standing water, reduce evaporation and subsequent salt accumulation in the soil profile, and efficiently drain low areas. As material becomes available, landowners would raise low pond bottom areas as needed or,

alternatively, they would use available material from high ground areas.

The volume of excavation fill material placed in the marsh would follow Exhibit A of the USACE RGP (see *Draft Environmental Assessment and Initial Study*) (SMPA 1998). The permit defines maximum allowable amounts of fill, which is defined as total cubic yards per ownership per year and determined by the size of the individual ownership. Exhibit A defines the maximum allowable amounts (in cubic yards) for exterior levees, interior levees, grading, drainage, and total cubic yards of work. The table also provides a linear-foot limitation for creation of V-ditches.

SRCD would verify that the work was conducted and satisfactory. All construction would be conducted within the Suisun Marsh construction season as defined by the USACE RGP and BCDC maintenance permit. All work would be done according to the special conditions defined in the permits.

Drought Response Fund

The Drought Response Fund (Article VII of Amendment Three) compensates landowners, including DFG, who have no alternative but to apply highly saline channel water [Table 5 of the *Draft Environmental Assessment and Initial Study* (SMPA 1998)] to their wetlands during periods of prolonged drought. These lands require more intensive management to restore wetland diversity lost from prolonged drought.

DWR and USBR would fund $72,000 per year to the Drought Response Fund for use when certain criteria are met. Drought response funding would be available in any year when the drought response criteria are triggered, and for one year beyond the last drought year meeting the trigger criteria.

Drought response funding and criteria are based on a frequency of monthly occurrence of salinity values above those in Article III of Amendment Three (Table 1), specifically a 40% frequency (two of five months) and 1.0 mS/cm exceedance of Table 1 values. Table 5 of the *Draft Environmental Assessment and Initial Study* (SMPA 1998) shows the channel salinity values that trigger the Drought Response Fund. These criteria are intended to represent the probable drought effect on accumulated soil water salinity as described in the *Demonstration Document* (DWR 1998).

Any one of the three conditions described in detail in the *Draft Environmental Assessment and Initial Study* (SMPA 1998) can trigger the Drought Response Fund. Management activities that would be funded include discing, preparing the seedbed, seeding, creating V-ditches, and operating portable pumps to increase leaching efficiency. Increasing leaching efficiency will help maintain soil water salinities within the natural range, helping to support plant diversity on managed wetlands.

These management activities would be conducted only within the Suisun Marsh maintenance season as defined by the USACE RGP and BCDC maintenance permit. All work would be done according to the special conditions defined in the permits.

Construction, Operation and Maintenance of Existing Facilities

Establishing Criteria for September SMSCG Operations

Article VIII of Amendment Three proposes a salinity criterion that would trigger Suisun Marsh salinity SMSCG operation in September. The original SMPA has no such criterion. Currently, SMSCG operation during September and the October through May control season is at the discretion of DWR, based on its determination of the need to meet marsh salinity standards under D-1485 and Order WR 98-9. Since operations began in November 1988,

the gates have been operated in September four times (44% of years): 1989 (4 days); 1990 (30 days); 1993 (14 days); and 1994 (28 days) (DWR 1997a). Operation during September in 1989 and 1990 coincided with tests to evaluate the effectiveness of SMSCG operations. During September 1993 and 1994, the SMSCG were operated to provide lower salinity water to the managed wetlands during the initial flooding period in the fall.

Operating the SMSCG in September helps to meet October salinity standards in Suisun Marsh and enables wetland managers to flood their properties with water of salinity lower than 19 mS/cm during the initial flooding period.

Under proposed Amendment Three, DWR and USBR would operate the SMSCG in September when the seven-day running average mean daily high-tide channel water salinity is 17 mS/cm or greater at any compliance station listed in Table 1 or at the S-35 monitoring station. Running averages for 1 through 6 September would be determined using salinity data from 26 through 31 August. The 17 mS/cm criterion is 2 mS/cm lower than the October salinity standard.

Such a criterion would provide DWR operators an objective value for determining when the SMSCG should be operated in September. The September value is not a channel salinity standard to be achieved like a compliance value. It is a trigger for operating the SMSCG and, as such, is not included in Table 3 of the *Draft Environmental Assessment and Initial Study* (Table 1 of Amendment Three).

DWR Suisun Marsh Planning staff analyzed data from SMSCG operations to estimate its effect on salinity at monitoring stations. Results of this analysis are described in Chapter 3 and summarized in Table 6 of the *Draft Environmental Assessment and Initial Study.* Results indicate SMSCG operations would be needed less frequently to meet marsh standards under the 1995 Water Quality Control Plan than under D-1485 hydrology. Results from recent modeling studies for a 73-year period of hydrology, indicate that SMSCG operation with the September criterion would be needed in 40% of the years under Amendment Three criterion as compared to 44% of the years without implementation of Amendment Three (past practices).

Operation of the SMSCG during September is already authorized in USACE permit 16223E58C and BCDC permit 4-84(M). The USACE permit does not impose any constraints on operation of the SMSCG during any time of the year. The only operational constraint imposed by the BCDC permit relates to boat traffic, stating that the flashboards will be removed during most of the boating season (late May through August). The *Suisun Marsh Pre-project Fishery Resource Evaluation* (Spaar 1988) states that the projected operation schedule would have the SMSCG operated from September through May when normal circulation would not provide water of adequate quality.

There are no physical modifications required to implement this action, which could begin the first September after the SMPA parties finalize Amendment Three.

Morrow Island Distribution System Fish Screens

Installation of a fish screen was specified as a requirement of the biological opinion issued in 1997 by the USFWS for Morrow Island Distribution System (MIDS) maintenance dredging. Construction and operation of the fish screen has been included in Amendment Three as an added operational obligation with respect to the MIDS, an existing facility (see Figure 1). DWR and USBR are currently designing the fish screen. The MIDS ECAT and Suisun

Marsh coordinators must approve any fish screen design. The target date for installation of the fish screen is summer 2000.

Lower Joice Island Unit Fish Screen

SCRD, with funding from DWR and USBR, completed a fish screen for the Montezuma Slough diversion of the Lower Joice Island Unit in 1998 (see Figure 1). The screen was required as a condition of constructing the facility in 1991. The specific requirement for constructing a fish screen is included in Amendment Three to clarify DWR's obligation for the Lower Joice Island Unit as an existing facility according to the original SMPA.

A ten-foot diameter conical screen was installed. This design is similar to the screens installed in the Suisun Marsh as part of the Suisun Marsh Diversion Screening Program and is monitored and maintained by SRCD. Flow through the intake is monitored and automatically adjusts to maintain maximum flow while still maintaining the USFWS delta smelt fish screen criteria of 0.2 ft/s within the tidal conditions of Suisun Marsh. The motor, gate actuator, and brushes to clean the screen are powered by a solar cell on site. Flow information is telemetered to the SRCD offices on Grizzly Island.

No other changes to the Lower Joice Island Unit are proposed under Amendment Three. The Joice Island Gun Club (Individual Ownership Number 424) will have ownership and responsibility for operation and maintenance of the screen.

Roaring River Distribution System Turnout Repairs

Amendment Three would fund the realignment and stabilization of selected existing turnouts along the levees of the Roaring River Distribution System (see Figure 1). This action would not increase the number or size of diversions off of the Roaring River Distribution System.

DWR and USBR would provide $60,000 to SRCD to assist landowners and DFG in making needed repairs to about 20 turnouts along the Roaring River Distribution System. Diversion capacity of these pipes has been reduced by as much as 75% due to uplifting of the pipes. Realignment and stabilization of the Roaring River Distribution System turnout pipes will return the pipes to their original design elevations, restoring the diversion capacity of water from the system.

Repairs will involve lowering the water level in the Roaring River Distribution System during late summer, after diversions for waterfowl habitat management have been completed. During this period, the landowners will realign and stabilize the pipes in place. The pipe would be exposed, supports would be attached to straighten the pipe, and the trench would be backfilled with the original material. Pile or pilings used for stabilization will not be creosote treated, which will avoid effects to aquatic habitat. If replacement of the pipes is necessary (at the owner's expense), the activities would be similar to that described under the "Managed Wetland Improvement Fund" section described previously.

Levees along Roaring River Distribution System are within the managed wetlands of the Suisun Marsh. The intakes to the RRDS are screened to meet the USFWS 0.2 ft/s approach velocity criteria established for the protection of delta smelt and winter-run chinook salmon.

Implementation of this action would occur during the Suisun Marsh construction season (summer) as defined by the SRCD's RGP and BCDC maintenance permits. Work would be conducted under special conditions defined in the permits. SRCD would verify that the work was conducted satisfactorily.

Goodyear Slough Outfall

No changes to the operation of the Goodyear Slough Outfall would occur under Amendment Three. However, maintenance of the facility, including trash and debris removal, will continue under Amendment Three.

Updating Management Plans

This action will provide funds to replace the original management plans developed in the early 1980s with new Individual Ownership Adaptive Management Habitat Plans created by SRCD for each property in the marsh. The management plans have not been modified or updated since they were written over 15 years ago and no longer reflect the properties' physical facilities and management constraints, or the current environmental and regulatory restrictions currently governing activities in the Suisun Marsh.

The new Individual Ownership Adaptive Management Habitat Plan (IOAMHP) should provide landowners with multiple management strategies to protect, conserve, and sustain brackish marsh species diversity, and waterfowl and wildlife values within the managed wetlands. Many of the actions proposed in Amendment Three and described in detail in the *Draft Environmental Assessment and Initial Study* (SMPA 1998) are directly related to the management strategies recommended in the new IOAMHPs.

A revised template for the IOAMHP is provided as Appendix A of this assessment. The revised template incorporates comments provided by USFWS, including a management strategy for pickleweed. The new IOAMHPs will include the following information to assist landowners in making yearly management decisions.

- A history of the Suisun Marsh.
- SRCD legislation and background.
- A HYDSAL hydrology report for each individual property.
- New property maps (facilities, soils, location).
- A description of water control facilities, and flood and drain requirements of each properties.
- Recommendations and needed improvements to meet the 30-day flood and drain requirements.
- New vegetation management strategies and schedules.
- A field guide to vegetation, including biological description of growth requirements, life cycle, wildlife values, length and timing of hydroperiod, and salt tolerance of the plants.
- Endangered species section (habitat requirements, imposed restrictions, and options for wetlands maintenance and management to protect habitats and species).
- USACE permit conditions and restrictions.
- A specific conductance chart.
- Soil information and physical characteristics.
- A description of wildlife nesting islands, loafing areas, brood habitat, and permanent ponds.
- Mosquito abatement requirements.
- Techniques for control of invasive species such as cattails, phragmites, and pepper weed.

- Descriptions of typical levee and ditch cross sections (primary, secondary, and V-ditches).

To create the new plans, a SRCD staff biologist will interview the private landowner and inspect the property to record the properties' physical facilities. SRCD will use HYDSAL, a hydrodynamic model developed for SRCD, to predict the hydrology of each individual managed wetland.

After the new plans are written, BCDC would need to certify them under provisions of the Suisun Marsh Preservation Act Local Protection Program. The certification process would include a public hearing. Re-certification of the plans would conform to the provisions outlined in the California Public Resources Code Sections 29000 through 29612, the policies of the Suisun Marsh Protection Plan, and the San Francisco Bay Plan. DFG would also need to approve the updated plans.

This action could be implemented immediately once the SMPA parties finalize Amendment Three. There are no physical modifications required to implement this action. However, several of the management actions recommended in the plans would require physical modifications.

Physical modifications as part of implementation of these new management plans would be conducted by the landowner under the RGP. All construction would be conducted within the Suisun Marsh construction season as defined by the RGP and BCDC maintenance permit. All work would be done according to the special conditions defined in the permits. SRCD would verify that the work was conducted and is satisfactory. Landowners receiving SMPA funds or assistance must follow their approved management plans or risk exclusion from SMPA actions and may be required to repay SMPA funds.

Water Manager Program

Amendment Three specifies that DWR and USBR would fund a maximum of $160,000 the first year and $140,000 in subsequent years to implement the Water Manager Program. SRCD would manage the Water Manager Program.

The 1995 SWRCB Water Quality Control Plan stated a need for a watermaster to direct the timing and amount of water diverted, ensure that the water is used efficiently, and maximize protection of beneficial uses. The Suisun Marsh Water Manager Program would not function as a watermaster, as defined in the State Water Code. Instead, the program would be similar to an agricultural extension service. This program would provide a cooperative service between SRCD and the private landowners of the marsh. The water managers would provide technical support to wetland managers and assist in the implementation of yearly management strategies as outlined in the IOAMHPs.

As described in Amendment Three, the Water Manager Program would include a biologist on staff. This biologist would primarily oversee field staff daily activities, as well as assist in making habitat management decisions, coordinate appropriate work activities, and assure endangered species issues are addressed when work is conducted.

The Water Manager Program would include, but not be limited to, the following services or duties to improve wetland managers' knowledge and ability to manage habitat, while sustaining a diversity of brackish marsh vegetation and wildlife values in the Suisun Marsh.

- Consult with landowners on recommendations of the IOAMHPs.

- Provide advice to landowners on management practices that benefit endangered species.
- Obtain agreements between the landowners and SRCD for coordinated water management.
- Assist landowners with yearly habitat management decisions and management operations.
- Facilitate Joint-use Facilities operation when multiple landowners are involved.
- Administer and coordinate the portable pump pool.
- Monitor the operation of fish screen facilities and perform routine maintenance.
- Collect water quality information on pond and channel waters (salinity, pH, dissolved oxygen, temperature).
- Check soil water salinities within the managed wetlands.
- Assist landowners in avoidance of vector production.
- Promote effective and efficient use of channel water.
- Avoid potential effects to fisheries resources and protect sensitive and listed species within the managed wetlands.

The water manager would be available in the field to answer questions and educate landowners on beneficial management techniques and the protection and enhancement of endangered species habitat, as well as provide new scientific information pertaining to common management activities. The landowners and water manager would discuss and agree upon a yearly wetland management goal for the property. This decision would be based on information from the IOAMHPs, and take into consideration yearly environmental and physical constraints of management, water diversion restrictions, protection of endangered species, and the enhancement of wetland species diversity.

The Water Manager Program may benefit marsh habitat by ensuring that wetland management activities such as flooding, draining, and circulation occur at the times of the year when they will most benefit plant species important to waterfowl and wildlife. The water managers may also be present during flood periods to ensure that the properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS. The water manager would monitor the operation of fish screen facilities on private property and perform routine maintenance to ensure that screen operation is in compliance with design criteria for the facility.

In addition, implementation of the Water Manager Program would help participating clubs adhere to their new management plans.

There are no physical modifications required to implement this action. This action could be implemented immediately after the SMPA parties finalize Amendment Three.

Joint-use Facilities

Joint-use Facilities are structures or activities used by two or more property owners to manage water either separately or jointly, as agreed upon. Structures may include interior levees, ditches, pumps, and water control structures. Joint-use Facilities can include newly constructed facilities or improvements to existing

facilities. The purpose of the Joint-use Facilities is to create efficient and cooperative use of water delivery systems for managed wetlands to enhance water management capability on many properties throughout the marsh. All activities will occur in managed wetlands and on interior levees, except for the new exterior drainage gates and discharge pumps.

DWR and USBR would fund the Joint-use Facilities. SRCD would be responsible for administration and implementation of the Joint-use Facility Program. Implementation depends on the Water Manager Program to coordinate improvements and facility operations. Once funding is available, several years would be required to make needed improvements.

Before obtaining funds for Joint-use Facilities, individuals would enter into a Joint-use Facility Agreement with SRCD. These agreements would require property owners to be responsible for operation and maintenance of the completed facility. SRCD would be responsible for coordinating the agreements.

SRCD's RGP R20066E98 authorizes work for all activities under this program. All activities covered under the permit have undergone environmental review by USFWS and NMFS. All permitted work activities within the project area must be carried out in accordance with the "Special Conditions" section of the permit.

The five proposed Joint-use Facilities activities are described below.

Cleaning Drainage and Circulation Ditches

Vegetation and sediment that accumulate in the ditches in managed wetlands reduce or prevent water conveyance and need to be removed regularly for efficient flooding and draining. This action also allows soil water salinity to be maintained at appropriate levels for vegetation growth. Vegetation and sediment is removed with a dragline or bucket excavator. This is an ongoing activity among the individual ownerships. Section 2a of the SRCD's RGP specifies limitations on spoil quantities for maintenance of drainage and circulation ditches. The permit does not allow excavation from the exterior side of marsh levees in tidal sloughs.

Core Common Levees

Muskrats, otters, and beavers may burrow into interior levees, allowing water to pass through the levee and possibly leading to levee failure. Common levees (levees shared by more than one property owner) can be repaired and water seepage reduced by coring.

Coring involves excavating a two-foot wide longitudinal trench on the common levee crown (which is normally 12 feet wide). The excavated material is placed on the crown of the levee adjacent to the excavation site. Finally, the material is backfilled into the trench and compacted to seal the levee. All work is done from the levee crown.

Interior Water Control Structures

Interior water control structures include pipes, weir boxes, and flashboard risers. These structures enhance the flooding and drainage capability and expand the management potential of managed wetlands. By hydraulically separating ponds or improving water control capability between multiple ownerships, wetland habitat may be enhanced. Repair, replacement, or enlargement (to improve drainage) of existing structures is required because the brackish environment causes them to corrode. Some structures would be replaced with plastic or vinyl parts that are resistant to corrosion.

Installation of up to 50 new culverts and water control structures per year is allowed under Section 2e of the RGP. Repair and replacement of culverts is allowed under Section 2d of the

RGP. There is no limit to the number of culverts that may be repaired or replaced.

New Interior Circulation Ditches

Interior circulation ditches, (primary ditches), guide water from the intake gates into the managed wetlands and ponds. V-ditches and secondary ditches run from the primary ditches to pond areas. All ditches are gravity fed. Ideally, the ditch system enables a 30-day flooding and drainage period of managed wetlands.

Primary ditches are 4 to 4.5 feet deep and 12 to 20 feet wide with a 2:1 slope. Secondary ditches are 3 to 3.5 feet deep and 6 to 10 feet wide with a 2:1 side slope. V-ditches are 18 to 24 inches wide and deep. With normal management (flooding and draining), V-ditches fill with sediment and vegetation every few years and requiring maintenance to keep them efficient. A dragline, bucket excavator, or earth scraper would be used to remove bottom material. Sidecast material from V-ditches may remain on the side of the excavated ditches; however, all other sidecast material from primary and secondary ditches would be spread over pond bottoms or placed on the crown of existing levees.

New Exterior Drainage Gates

New exterior drainage gates could be installed and would increase the drainage capabilities of the managed wetlands. Existing drainage gates may also be lowered to improve drainage capability under this provision as well.

To avoid potential negative impacts to tidal wetlands, new discharge sites would be located where discharge channels already exist or where exterior levees are unvegetated.

Drainage gate installations would occur during a single low tide. The gates are attached to the pipe prior to placement in the levee. A trench is excavated using a dragline or bucket excavator and the pipe with gates attached is placed in the trench.

Installation of new drainage structures is permitted under existing RGP R20066E98. A special condition of the permit addressing endangered species states that work cannot be conducted within 500 feet of an exterior levee during the California clapper rail breeding season in designated critical habitat areas. All projects would comply with the RGP restrictions and consider timing constraints so as not to affect California clapper rails.

Implementation of Joint-use Facilities would likely occur over time. Landowners would enter into Joint-use Agreements with the assistance of SRCD. All construction and maintenance activities would be conducted within the Suisun Marsh construction season as defined by the SRCD's RGP and BCDC maintenance permit. All work would be conducted under special conditions defined in the permits. SRCD would verify that the work was conducted satisfactorily.

Many site-specific issues important to sensitive species have been addressed by the biological opinions and SRCD's RGP special conditions. Adherence to the required measures during Joint-use Facilities maintenance work in Suisun Marsh should not adversely affect sensitive species or other local species. DFG biologists will conduct a survey for sensitive plant species prior to the installation of exterior drain gates.

Portable Drainage Pumps

The portable pump pool, consisting of 20 pumps, would be managed by SRCD and funded by DWR and USBR. SRCD, in conjunction with the Water Manager Program would oversee portable pump operation and maintenance, and assist landowners in effective and efficient use.

This program would allow managers to control water levels and maintain appropriate water management during growth periods critical to wetland plants. On properties with low pond bottom elevations, pumps would be used to remove or accelerate the drainage time of saline water. The ability to drain managed wetlands within a 20-day period is a requirement of each property's management plan. Most managed wetlands with an average pond bottom elevation below 2.70 feet, mean lower-low water at the Golden Gate cannot tidally drain effectively. The mean pond bottom elevation for effective tidal drainage is 3.30 feet, mean lower-low water in the northwestern portions of Suisun Marsh due to siltation in these smaller sloughs. Properties with low mean pond bottom elevations do not have enough dwell time at the lowest of tides to permit effective tidal drainage.

Of the 158 privately owned and managed wetlands, 73 do not now have the ability to drain within 20 days as was determined in a July 1995 evaluation conducted by SRCD (SRCD 1995).

The portable pumps could be used year-round for effective habitat management, but the primary use for drainage would begin in the winter and spring when habitat management and maintenance of soil salts in the root zone is most critical. The pumps would be placed adjacent to existing drainage gates. These drains now have supply ditches that are adequate to accommodate the pumps. When use is complete, the pumps would be moved to another site or back to the storage yard. Pump operation would not increase the total volume of water being discharged, but it would decrease the period of time the same volume of pond water is being returned to the bays and sloughs. These pumps discharge less than an acre-foot of water per hour.

The 20 pumps would likely be stored in various locations throughout the marsh and made available to landowners to share efficiently. Pumps from the pump pool would be available for use in the SMHM mitigation conservation areas.

There are no physical modifications required to implement this action. The pumps would be placed on levee crowns. Water will be discharged through collapsible aluminum pipes across levees. No concrete pads will be placed. Pumps could be purchased immediately and used as needed once the SMPA parties finalize Amendment Three.

Portable Diversion Pumps with Fish Screens

The 20 portable pumps would be fitted with detachable fish screens enabling managers to divert channel water onto their wetlands. The pumps would be screened in accordance with DFG criteria. The screens will be designed to comply with USFWS delta smelt fish screen approach velocity criteria of 0.20 ft/s and NMFS salmonid approach velocity criteria of 0.33 ft/s. The fish screen design for these portable pumps would be reviewed and approved by the Interagency Fish Screening Committee before implementation.

The pump pool would be managed by SRCD in conjunction with the Water Manager Program. SRCD would oversee portable pump and fish screen operation and maintenance, and assist landowners in proper use of the pumps. Landowners could be reimbursed for pumping costs under the 50/50 Cost-share Program.

The portable pumps may be used year-round for effective habitat management. The primary use, however, would be for water diversions in late summer and early fall to initially fill managed wetlands, and in the spring and early summer when habitat management and control

of soil salts from the root zone is most critical. Use of portable pumps would allow managers to actively flood their wetlands with lower salinity water than is available with passive flooding methods. Rather than depending on weirs and high tide levels, pumps could be used at various times and locations to take advantage of the lower salinity water available throughout the tidal cycle. The ability to flood wetlands selectively would help control soil water salinity. Use of portable pumps would enable managers to flood wetlands more quickly, and thus achieve the recommended ten-day filling period. This should benefit wetlands with relatively high pond bottom elevations.

The screened pumps could be placed throughout the marsh where existing intake gates divert water. These sites have adequate supply ditch systems that would allow for effective pump use and water conveyance. When these screened pumps have diverted enough water for appropriate habitat management, they would be moved to another site or returned to the storage yards.

These pumps would likely be stored in various locations throughout the marsh and made available so landowners could make efficient use of a limited pump pool resource.

A maximum of $400,000 will be spent to purchase 20 portable pumps and $100,000 will be spent for the detachable fish screens required for the intake pumps. Only portable pumps equipped with fish screens will be used for intake diversions in Suisun Marsh.

There are no physical modifications required to implement this action. Pumps could be purchased immediately and used as needed once the SMPA parties finalize Amendment Three.

Chapter 5
MAMMALS

Salt Marsh Harvest Mouse, *Reithrodontomys raviventris*

Status

The salt marsh harvest mouse (SMHM) was listed as endangered by the USFWS in 1970. The California Fish and Game Commission listed the SMHM as endangered in 1971. A recovery plan for the species was prepared by the USFWS in 1984 and is currently under revision.

Distribution

The SMHM is endemic to the San Francisco Bay Estuary, occurring in marshes bordering the San Francisco, San Pablo, and Suisun bays. The northern subspecies (*Reithrodontomys raviventris halicoetes*) is found on the upper portions of the Marin County peninsula; in the Petaluma, Napa, and Suisun marshes; and on the northern Contra Costa County coast. The southern subspecies (*R. r. raviventris*) is found in marshes bordering south San Francisco Bay near Richmond and on the lower Marin County peninsula (Fisler 1965; USFWS 1984).

Habitat

In the recovery plan (USFWS 1984), preferred SMHM habitat was described as possessing the following attributes.

- Each marsh area should be large.
- There should be 100% vegetative cover.
- Cover should be 12 to 20 inches high at summer maximum.
- The area should be composed primarily (60% or more) of pickleweed (*Salicornia virginica*) with a variety of other halophytes, especially fat hen (*Atriplex triangularus*) and alkali heath (*Frankenia salina*).
- There should be little or no salt grass (*Distichlis spicata*), brass buttons (*Cotula coronopifolia*), cattail (*Typha* sp.), alkali bulrush (*Scirpus maritimus*) or other species of *Scirpus*.
- There should be an upper edge of halophytes or annual grasses adjoining wetland habitat to provide refugia during flooding.
- There should be no physical barriers of open ground or water dissecting wetland vegetation.
- At least 40% of the vegetation should be available to the SMHM in winter.
- The area should receive minimal disturbance, especially in the forms of freshwater flushing, plowing, mowing, or burning.
- The corridors connecting adjacent habitat should be at least 65 feet wide and possessing all previously listed characteristics.

In Suisun Marsh, SMHM have been found primarily in areas dominated by pickleweed, but Botti and others (1986) and Shellhammer

(Harvey and Stanley 1980) found SMHM in areas where pickleweed was present in very small quantities.

In the recovery plan, the USFWS did not declare any critical habitat within the Suisun Marsh; however, several areas were classified as essential, including Joice Island north, Joice Island south, Suisun Slough north (the area between Goat Island and the mouth of Wells Slough), and Collinsville (USFWS 1984).

In 1981, the USFWS issued a biological opinion for the *Suisun Marsh Plan of Protection* (USFWS 1981), in which the USFWS expressed concern that the implementation of the plan and more intensive management practices on both State and private wetlands could result in the reduction of preferred SMHM habitat. To compensate for this potential loss, the USFWS required the following conservation measures.

- Baseline acreage of preferred SMHM habitat was to be mapped using the 1981 triennial vegetation survey flight. In subsequent flights, a change in preferred habitat was to be considered significant when the acreage decreased by one-third in any of five zones (see Figure 2). If losses were detected, management plans were to be modified to assure that substantial tracts of preferred habitat were retained, and that any degraded habitat was restored.

- Retain and monitor at least 2,500 acres of preferred SMHM habitat adequately distributed throughout the marsh.

- Approximately 1,000 acres of State lands, and appropriate portions of future acquisitions, were to be set aside and managed as preferred SMHM habitat.

- To compensate for the loss of 340 acres of wetland, including 100 acres of SMHM habitat, comparable amounts of habitat were to be developed. The 100 acres were to be managed as preferred SMHM habitat.

At this time, the baseline assessment of SMHM preferred habitat has not been done. The 2,500 acres were not delineated until January 1999 and have not yet been monitored.

As described in the "Mitigation and Monitoring" section, the DFG set aside State lands in Suisun Marsh as preferred SMHM habitat (see Figure 2), and prepared a management plan (DFG 1987) for these conservation areas that included (1) water and habitat management of areas set aside as SMHM habitat; (2) future acquisitions of SMHM habitat; (3) monitoring to establish baseline conditions of the seven conservation areas (4) ongoing monitoring of the vegetation and SMHM populations of the seven areas including annual surveys along permanent vegetation transects and SMHM surveys every three years in conjunction with a marshwide triennial vegetation survey; and (5) project review.

During baseline trapping in 1988, SMHM were found in only four of the seven areas. Of the three areas where mice were not found, one had recently burned and one area was flooded. SMHM have since been found at these three areas. The permanent vegetation transects were not established at the conservation areas and neither the annual vegetation surveys nor the SMHM trapping in conjunction with the marshwide, triennial vegetation survey have been done.

As described in the "Mitigation and Monitoring" section, the signatories to the SMPA have formed an ECAT to assure future compliance with permit and monitoring requirements.

The ECAT is currently working with the USFWS to meet the SMHM mitigation obligations.

General Ecology

The SMHM is a small cricetid rodent, averaging about ten grams. The species is crepuscular and partially diurnal in its activity and generally has a very calm temperament. The species' docile behavior may be responsible for its need for dense cover habitat (Shellhammer 1977). SMHM differ from many other small rodents in that they do not burrow. Nests of *R. r. halicoetes* are often a loose ball of dry grasses or sedge built on the surface of the ground. The mice swim strongly and well.

The breeding season of *R. r. halicoetes* generally occurs from May through November, the average litter size is 3.8, and there is probably only one litter per year (Fisler 1965). Population levels fluctuate seasonally, but are generally highest in the late summer to early fall.

Stomach contents of SMHM were found to contain primarily plant fibers and a few seeds. They are believed to forage primarily on green vegetation rather than seeds because of the low seed production of most tidal marshes. Insects are not known to make up a significant portion of the diet (Fisler 1965).

Occurrence in the Project Area

The SMHM occurs throughout the Suisun Marsh, in both tidal and managed wetlands. There are a number of museum specimens (Fisler 1965) and DFG Natural Diversity Data Base historical occurrences from Grizzly Island, Cordelia, and Collinsville, in addition to the Contra Costa County shoreline along the southern shore of Suisun Bay. In 1980, Shellhammer (Harvey and Stanley 1980) conducted trapping at 24 sites in the marsh and found SMHM at eight sites. Since 1980, most trapping has been conducted by DFG on State lands. Pre-1999 SMHM trapping locations within Suisun Marsh are shown in Figure 5. Current SMPA SMHM trapping efforts are described in chapter 2 "Mitigation and Monitoring."

Project Impacts

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

The potential effects to special status species were addressed in the Environmental Report (Appendix 1) of the *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (SWRCB 1995). SWRCB concluded that the standards should preserve a salinity gradient within the unmanaged tidal marshes of the estuary, including those in the Suisun Marsh. In the managed wetlands, the conditions should remain the same in the eastern marsh, and may become slightly more saline in the western marsh. The proposed increases in freshwater outflow are within the historical salinity ranges and are not expected to adversely affect the SMHM.

The proposed Amendment Three channel salinity standards should not affect the natural (east-west and north-south) salinity gradient in the marsh. The salinity standards are upper limits, as are those required by SWRCB permit conditions in Order WR 98-9. These standards do not establish lower salinity limits. Except in very wet years, the natural salinity gradient will be higher in the western marsh as expected under the natural gradient. In addition, the original SMPA and water right permit standards do not interfere with the natural gradient because they provide for defined "deficiency periods" with appropriate relaxation of standards. These standards allow for increased salinity in the western marsh during drier years as would occur under a natural salinity gradient.

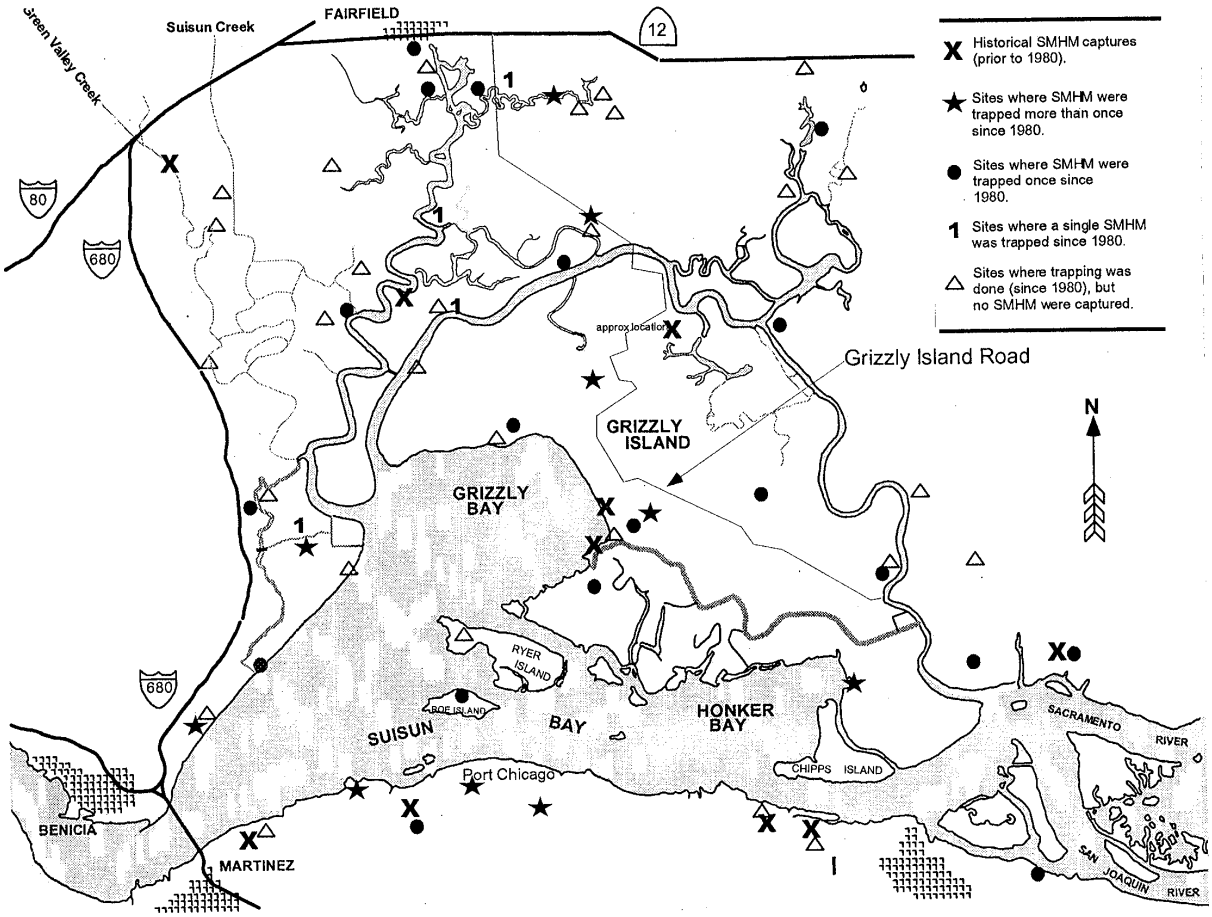

Figure 5 Salt marsh harvest mouse trapping locations within Suisun Marsh

Converting S-35 and S-97 to Monitoring Stations

By converting S-35 and S-97 to monitoring stations, channel water salinity in the western marsh would, at times, be higher than the Order WR 98-9 standards. This should have no net effect on SMHM habitat in the western marsh because, while these more saline conditions may exceed the optimal levels for pickleweed in some areas, in other areas conditions will become more favorable for pickleweed habitat. Established pickleweed habitat is resilient to short-term changes in salinity and should show few deleterious effects. Net change in pickleweed acreage should be very small.

Tidal wetlands could benefit from these periods of higher channel water salinities. This could benefit SMHM habitat within tidal areas of the marsh. Increased channel water salinity could increase the seasonal variability of salinity in the marsh over that of current D-1485 and Order WR 98-9 salinity standards.

Managed Wetlands Improvement Fund

SMHM habitat may be adversely affected if pond managers who currently provide SMHM habitat use improved fill-and-drain capability to change their management regime to include leaching cycles and longer hydroperiods. These changes could cause habitats to change from pickleweed to vegetation that is less salt

tolerant. However, implementation of this action will not result in additional effects to federally protected species beyond those previously identified in the 1981 biological opinion (USFWS 1981) for the project area. Effects to SMHM were addressed in the 1981 biological opinion and a mitigation plan for this species was developed (see the "Mitigation and Monitoring" section). Fulfillment of this obligation will mitigate potential effects to State and federally protected species. The Suisun Marsh ECAT will ensure mitigation compliance. All work activities would adhere to the special conditions and the limitations of SRCD's RGP.

SMHM habitat may be positively affected in areas where current drainage facilities cannot effectively remove water. Poor drainage facilities can result in the occurrence of the following management problems.

- The extension of the length and depth of soil submergence. This is detrimental to pickleweed and many other wetland plants (and SMHM).

- Deep water in ponds due to periods of heavy winter and spring rains, high tides, or high Delta outflow. High water levels cause inundation of shallowly flooded emergent vegetation, pond margins, and upland areas that provide SMHM refugia within the managed wetlands.

- Ponding of drainage water resulting in high evaporative losses and the accumulation of salts within the soil. If salts accumulate to levels above those characteristic of Suisun Marsh, vegetation dies back and the amount of bare ground increases. If increases in bare ground occur in SMHM habitat, the habitat value decreases as the habitat fragments. These areas will not revegetate until soil water salinities are reduced to levels capable of supporting plant life.

Drought Response Fund

Increased discing would have direct effects on SMHM if areas occupied by SMHM are destroyed. However, implementation of this action will not result in additional effects to federally protected species beyond those previously identified in the 1981 biological opinion for the project area. All work activities would adhere to the special conditions and the limitations of SRCD's RGP.

The Drought Response Fund would only be triggered if the criteria are met. Therefore, if the deficiency standards are exceeded at S-97 or S-35 in less than two months during one year, there will be no additional management activities.

Operation and Maintenance of Existing Facilities

Installation of fish screens at Morrow Island and Joice Island is not expected to affect the SMHM.

Criteria for September SMSCG Operations

Because SMHM are known to occur in tidal marsh areas within Suisun Marsh, they could be influenced by SMSCG operations. The important factor with regard to this species and sensitive communities is that September SMSCG operations will likely not result in increased depth and duration of flooding on tidal marsh surfaces. Changes in water elevations and related changes in soil redox potential and biological interactions are known to be controlling mechanisms in marsh plant pattern and dynamics. The traditional view that salinity regimes are the controlling mechanism of marsh spatial pattern and dynamics only holds true on the broadest landscape scales and does not explain patterns at the scales relative to this project.

SMSCG operations may have effects to the SMHM conservation area at DFG Pond 1. This conservation area is located near the SMSCG and floods with water from Montezuma Slough. Operation of the SMSCG has decreased the salinity of water that this area is flooded with. To increase salinity of the water in the pond, flooding could be initiated in August rather than September or October, with no circulation of pond water.

Updating Management Plans

If the plans are widely successful at lowering soil water salinity, pickleweed acreage may be lost. However, implementation of this action will not result in additional effects to federally protected species beyond those previously identified in the 1981 biological opinion for the project area.

Water Manager Program

This action may have significant incremental effects over the original SMPA as it has been implemented. The *Biological Assessment for the Plan of Protection* (DWR 1984) addressed the effects of the implementation of the management plans. Shellhammer addressed the worst case scenario, and postulated that if all the hunting clubs were managed with maximum effectiveness, that "the future of the mouse in the Suisun Marsh is dubious" (Harvey and Stanley 1980). The *Biological Assessment for the Plan of Protection* (DWR 1984) acknowledged that full compliance with the management plans was not likely, but recommended that DFG lands be set aside as preferred SMHM habitat to assure the mouse's survival in the marsh. In fact, there has not been full compliance with the water management plans, so the potential effects of those plans have not been realized, and the SMHM continues to inhabit the managed wetlands of the marsh.

It is not known how many hunting clubs are currently vegetated with pickleweed, how many are inhabited by SMHM, how many will choose a management plan that may result in the loss of SMHM habitat, or how many will choose a management plan that will result in the creation or improvement of SMHM habitat. Some hunting clubs in the marsh purposely "manage for" pickleweed, and these will probably continue to do so. Management for pickleweed is best accomplished with a short hydroperiod and quick drainage at the end of waterfowl season, and the Water Manager Program could help hunting clubs achieve this goal.

It could also benefit pickleweed to receive a short, shallow, summer irrigation. Because of mosquito abatement restrictions, these irrigations can be impossible for hunting clubs without full-time managers. The water manager could make these difficult manipulations, resulting in improved pickleweed habitat.

Since the primary goal of the Water Manager Program is to ensure appropriate water management to limit peaks in soil water salinity, there is the potential for loss of pickleweed and SMHM habitat. However, implementation of this action will not result in additional effects to federally protected species beyond those previously identified in the 1981 biological opinion for the project area.

Joint-use Facilities Program

SMHM may be affected by the creation of new circulation ditches. Potential effects would be damage to, or fragmentation of, habitat due to excavation of new ditches. Excavated material would not be placed on any sensitive habitats or on the waterside of levees. Spoil is typically placed on the crown of an adjacent interior levee. If there are no adjacent interior levees, the material may be exported by truck and placed on the crown of exterior levees or in low pond bottom areas to raise elevation. Adherence to all measures described in the RGP during maintenance and construction

should avoid adversely affecting this endangered species. Implementation of this action will not result in additional effects to federally protected species beyond those previously identified in the 1981 biological opinion for the project area.

SMHM habitat may be positively affected in areas where current drainage facilities cannot effectively remove water. Poor drainage facilities can result in the occurrence of the management problems discussed in the preceding "Managed Wetlands Improvement Fund" section.

Portable Pumps Program

Implementation and operation of the portable drainage pumps in conjunction with the Water Manager Program would enhance and sustain a diverse assemblage of wildlife habitat throughout the Suisun Marsh. This action will allow managers to maintain appropriate water management levels during critical growth periods, thus providing a net benefit to wetlands and wetland-dependent wildlife of the marsh.

SMHM habitat may be positively affected in areas where current drainage facilities cannot effectively remove water. Poor drainage facilities can result in the occurrence of the management problems addressed in the preceding "Managed Wetlands Improvement Fund" section.

There is the potential that use of pumps for more rapid drainage followed by leach cycles may reduce soil water salinity and change areas currently vegetated with pickleweed to less salt-tolerant vegetation. However, implementation of this action will not result in additional effects to federally protected species beyond those previously identified in the 1981 biological opinion for the project area. All work activities would adhere to the special conditions and the limitations of SRCD's RGP.

Critical Habitat

There is no designated critical habitat for the salt marsh harvest mouse in the project area.

Existing Environment and Cumulative Effects

Current and ongoing (human-caused) negative effects to the SMHM and its habitat in Suisun Marsh include the following.

- Habitat patches tend to be small, fragmented, and isolated from one another.
- Management of diked wetlands, including nontidal flooding regimes.
- Managed wetland work activities, such as ground manipulation like ditching, discing, and burning.
- Mosquito abatement activities.
- Water quality considerations, especially Mercury contamination.
- Take by domestic cats from the Lawler Ranch subdivision and the release of feral cats.

The immediate and long-term effects of wetland management activities on the SMHM are not quantitatively known. However, management of the diked wetlands in Suisun Marsh has occurred for decades, and the SMHM continues to inhabit these wetlands. Further studies are necessary to better assess the effects of management on SMHM and to devise actions that will provide seasonal waterfowl habitat, as well as habitat for the SMHM.

Wetland losses through such actions such as diking, back-filling, and filling of tidal and coastal marshes have had the greatest negative effect on the SMHM.

Conclusion and Determination

Although management actions in Amendment Three may have adverse effects on SMHM, they are not expected to be substantially greater than those already present under current management. The RGP allows much more habitat manipulation than is currently done in the marsh, and any increase above current levels will certainly be within the limits of the RGP. Compliance with mitigation requirements will provide and maintain habitat for the SMHM. Further studies are recommended to assure that SMHM will continue to inhabit the privately owned diked wetlands.

Suisun Shrew, *Sorex ornatus sinuosus*

Status

The Suisun shrew is a DFG California species of special concern and a federal species of special concern. As such, the species has no official State or federal status, though it is considered in Environmental Assessments, Environmental Impact Reports, and Environmental Impact Statements. Very little is known about the Suisun shrew, as there have been very few recent captures, and the historical literature is limited.

Distribution

The Suisun shrew is confined to tidal and brackish marsh communities of the north shores of San Pablo and Suisun bays, from Sonoma Creek in Sonoma County on the west and eastward to about Collinsville in Solano County (Williams 1983). There have been no documented captures in diked wetlands (Rudd 1955).

Habitat

The shrew typically inhabits the margins of middle elevation saltwater or brackish marshes, characterized by cordgrass (*Spartina* sp.), pickleweed (*Salicornia* sp.), and gum plant (*Grindelia* sp.). The structure of the habitat appears to be more important than the species composition of the plant community. The shrew seems to require areas of fairly constant soil moisture with dense, low-lying plant cover, abundant invertebrates, and where driftwood and other litter is available above the mean high tide line for nesting and foraging (WESCO 1986; Williams 1983). Upland refugia are essential for escape from inundation. Hadaway and Newman (1971) captured shrews most often at the interface between *Salicornia* marsh and upland levees vegetated with coyote brush (*Baccharis pilularis*) and grasses.

In Suisun and San Pablo bays, Williams (1983) found that most of the upland areas adjacent to Suisun shrew habitat were sparsely vegetated dikes which could not support a population during prolonged flooding. Hays (1990) found that several vegetation types were used by shrews, but generally, they seemed to prefer clumps of *Salicornia* and *Jaumea* in the fall, and were most often found in *Triglochin* in the winter and early spring.

The extent to which Suisun shrews use diked wetlands is unknown. Most documented captures were from tidal marshes, so it appears that the Suisun shrew prefers tidal over diked marshes (WESCO 1986). A study by WESCO (1986) postulated that shrew populations in the diked marshes may be limited by the relative unavailability of invertebrate prey, and that management activities such as mowing, discing, and prolonged flooding, may limit shrew use of the diked wetlands to a seasonal basis.

General Ecology

The Suisun shrew is a small insectivore (95 to 105 mm total length), with a long pointed rostrum, visible external ears, and a well-developed scaly tail. It preys on small insects and crustaceans. The pelt is usually very dark, almost black, with a clove-brown underside. The venter coloration is the one field characteristic used to differentiate it from the California shrew, *S. o. californicus*, which is silver-gray on its underside, and occurs within the marsh habitat of the Suisun shrew.

Suisun shrews are active both day and night, with activity patterns changing with season and reproductive condition, but nocturnal

activity predominates, especially during the breeding season.

Most breeding occurs from early spring through May, by shrews born early the previous year. Males compete for females, and aggregations of shrews are formed, with a harem of females and one dominant male (Hays 1990). A second breeding effort may occur in September, probably by shrews born in late summer of the previous year. Nests are built of plant material and paper scraps and are placed under or in driftwood found along the high tide line. The nest is small (less than two inches in diameter), cup-like, and usually domed. Gestation for related species is about 20 days and litters average about five young. It is assumed that the gestation and litter size in the Suisun shrew is about the same. Females begin weaning the young at 16 days, and the process is completed by day 25. The young remain in the nest for up to five weeks, and then disperse (WESCO 1986).

Shrews usually live less than one year, though some may live into their second year. Few survive to their second winter; 18 months is about the maximum life span of Suisun shrews (WESCO 1986).

Occurrence in the Project Area

Historically, Suisun shrews were known from a number of Suisun Marsh localities. Museum specimens of Suisun shrews were taken from Cordelia salt marsh, 1.5 miles southwest of Suisun, Grizzly Island, Van Sickle Island, and Suisun City.

Surveys during the early and mid-1980s identified only one Suisun shrew, which was found dead on the road near DFG headquarters (Williams 1983). During this 1983 survey for shrews, only one live shrew, identified as a California shrew *S. o. californicus*, was trapped near Collinsville. A trapping survey for Suisun shrews in 1985 and 1986 (WESCO 1986), also captured only one shrew in Suisun Marsh. This shrew, captured in tidal wetlands along Suisun Slough, was determined to be a California shrew.

Hays (1990) trapped 161 ornate shrews in the tidal marsh at Rush Ranch, in north-central Suisun Marsh. These shrews displayed numerous color morphs from the typical gray venter of *S. o. californicus* to the deep brown typical of *S. o. sinuosus*, and were considered to be an interbreeding population. Over the last 20 years, several shrews have been captured during efforts to trap salt marsh harvest mice in the Suisun Marsh, but these were identified only as *Sorex* or *Sorex ornatus*.

Project Impacts

The following Amendment Three actions are not expected to have any effects on the Suisun shrew.

- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repairs.

However, there would be fewer benefits from increased drainage capability, such as shorter hydroperiod, shallower flooding, and revegetation of bare areas.

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

The potential effects to special status species were addressed in the Environmental Report (Appendix 1) of the *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (SWRCB 1995). The SWRCB concluded that the standards should preserve a salinity gradient within the unmanaged tidal marshes of the estuary, including Suisun Marsh. In the managed wet-

lands, the conditions should remain the same in the eastern marsh and may become slightly more fresh in the western marsh. The proposed increases in freshwater outflow are within the historical salinity ranges and are not expected to adversely affect the shrew.

The proposed Amendment Three channel salinity standards should not affect the natural (east-west and north-south) salinity gradient in the marsh. The salinity standards are upper limits, as are those required by SWRCB permit conditions in Order WR 98-9. These standards do not establish lower salinity limits. Except in very wet years, channel water salinity will be higher in the western marsh, as expected under the natural gradient. In addition, the original SMPA and water right permit standards do not interfere with the natural gradient because they provide for defined "deficiency periods" with relaxation of standards. These standards allow for increased salinity in the western marsh during drier years as would occur under a natural salinity gradient.

Converting S-35 and S-97 to Monitoring Stations

By converting S-35 and S-97 to monitoring stations, channel water salinity in the western marsh would, at times, be higher than Order WR 98-9 standards. Tidal wetlands could benefit from increased channel water salinities during these periods of higher channel water salinities. This could benefit shrew habitat within tidal areas of the marsh.

Managed Wetland Improvement Fund

It is not known whether the shrew occurs in diked wetlands. If it does, it would most likely co-occur with the SMHM in pickleweed-dominated habitats. Suisun shrew habitat may be adversely affected if managers of ponds that currently provide shrew habitat use improved fill-and-drain capability to change their management regime to include leaching cycles and longer hydroperiods. These changes could cause habitats to change from pickleweed to vegetation that is less salt tolerant. However, implementation of this action will not result in additional effects to SMHM habitat (and the Suisun shrew) beyond those previously identified in the 1981 biological opinion (USFWS 1981) for the project area. Effects on the mouse were addressed in the 1981 biological opinion and a mitigation plan for this species was developed (see "Mitigation and Monitoring"). Fulfillment of this obligation will mitigate potential effects on the mouse and the shrew. The Suisun Marsh ECAT will ensure mitigation compliance. All work activities would adhere to the special conditions and the limitations of SRCD's RGP.

Suisun shrew habitat may be positively affected in areas where current drainage facilities cannot effectively remove water. Poor drainage facilities can result in the occurrence of the following management problems.

- The extension of the length and depth of soil submergence. This is detrimental to pickleweed as well as many other wetland plants and shrews.

- Deep water in ponds due to periods of heavy winter and spring rains, high tides, or high Delta outflow. High water levels cause inundation of shallowly flooded emergent vegetation, pond margins, and upland areas that provide shrew refugia within the managed wetlands.

- Ponding of drainage water resulting in high evaporative losses and the accumulation of salts within the soil. If salts accumulate to levels above those characteristic of Suisun Marsh, vegetation dies back and the amount of bare ground increases. If increases in bare ground occur in shrew habitat, the habitat value decreases as the habitat frag-

ments. These areas will not revegetate until soil water salinities are reduced to levels capable of supporting plant life.

Drought Response Fund

It is not known whether the shrew occurs in diked wetlands. If it does, it would most likely co-occur with the SMHM in pickleweed-dominated habitats. Increased discing could have direct effects on the Suisun shrew if areas occupied by the shrew are destroyed. However, implementation of this action will not result in additional effects to SMHM habitat (and the Suisun shrew) beyond those previously identified in the 1981 biological opinion for the project area. All work activities would adhere to the special conditions and the limitations of SRCD's RGP.

The Drought Response Fund would only be triggered if the criteria are met. Therefore, if the deficiency standards are exceeded at S-97 or S-35 in less than two months during one year, there will be no negative effects to shrew habitat in managed wetland areas.

Establishing Criteria for September SMSCG Operations

Historically, the Suisun shrew was known to occur in tidal marsh areas within Suisun Marsh, and it is assumed to be extant there. This environment is influenced by SMSCG operations.

The important factor with regard to the tidal wetlands is that September SMSCG operations will not result in increased depth and duration of flooding on tidal marsh surfaces. Changes in water elevations and related changes in soil redox potential and biological interactions are known to be controlling mechanisms in marsh plant pattern and dynamics. The traditional view that salinity regimes are the controlling mechanism of marsh spatial pattern and dynamics only holds true on the broadest landscape scales and does not explain patterns at the scales relative to this project.

Updating Management Plans

If the plans are widely successful at lowering soil water salinity, pickleweed acreage may be lost. However, implementation of this action will not result in additional effects to SMHM habitat (and the Suisun shrew) beyond those previously identified in the 1981 biological opinion for the project area. All work activities would adhere to the special conditions and the limitations of SRCD's RGP.

Water Manager Program

If the shrew inhabits the managed wetlands, this action may have significant incremental effects over the original SMPA as it has been implemented. If the Water Manager Program is widely successful at lowering soil water salinity in the managed wetlands, pickleweed habitats for the shrew will be lost. It is not known how many hunting clubs are currently vegetated with pickleweed, how many are inhabited by the Suisun shrew, how many will choose a management plan that may result in the loss of shrew habitat, or how many will choose a management plan that will result in the creation or improvement of shrew habitat. Some hunting clubs in the marsh purposely "manage for" pickleweed, and these will probably continue to do so. Management for pickleweed is best accomplished with a short hydroperiod and quick drainage at the end of waterfowl season, and the Water Manager Program could help hunting clubs achieve this goal.

It could also benefit pickleweed to receive a short, shallow, summer irrigation. Because of mosquito abatement restrictions, this can be impossible for hunting clubs without full-time keepers and managers to implement. The water manager could make these difficult manipulations, resulting in improved pickleweed habitat.

Since the primary goal of the Water Manager Program is to ensure appropriate water management, which would limit peaks in soil water salinity, there is the potential for loss of pickleweed and shrew habitat. However, implementation of this action will not result in additional effects to SMHM habitat (and the Suisun shrew) beyond those previously identified in the 1981 biological opinion for the project area. All work activities would adhere to the special conditions and the limitations of SRCD's RGP.

Joint-use Facilities Program

It is not known whether the shrew occurs in diked wetlands. If it does, it would most likely co-occur with the SMHM in pickleweed-dominated habitats.

The Suisun shrew may be affected by the creation of new circulation ditches. Potential effects would be damage to, or fragmentation of, habitat due to excavation of new ditches. Excavated material would not be placed on any sensitive habitats or on the waterside of levees. Spoil is typically placed on the crown of an adjacent interior levee. If there are no adjacent interior levees, the material may be exported by truck and placed on the crown of exterior levees or in low pond bottom areas to raise elevation.

Implementation of this action will not result in additional effects to the habitat of the SMHM (and the Suisun shrew) beyond those previously identified in the 1981 biological opinion for the project area. All work activities would adhere to the special conditions and the limitations of SRCD's RGP.

Suisun shrew habitat may be positively affected in areas where current drainage facilities cannot effectively remove water. Poor drainage facilities can result in the occurrence of the management problems listed in the preceding "Managed Wetland Improvement Fund" section.

Portable Pumps Program

Implementation and operation of the portable drainage pumps in conjunction with the Water Manager Program would enhance and sustain a diverse assemblage of wildlife habitat throughout the Suisun Marsh. This action will allow managers to maintain appropriate water management levels during critical growth periods, thus providing a net benefit to wetlands and wetland-dependent wildlife of the marsh.

During periods of heavy winter and spring rains, high tides, or high Delta outflow, pond water elevations can rise to undesirable levels for extended periods of time. The operation of portable pumps will increase the capability of wetland managers to avoid excessively high water levels, and prevent inundation of shallowly flooded emergent vegetation, pond margins, and upland area that provide shrew refugia within the managed wetlands.

Critical Habitat

There is no designated critical habitat for the Suisun shrew in the project area.

Existing Environment and Cumulative Effects

Assuming that the Suisun shrew occupies the same habitats as the SMHM, effects on the mouse would also affect the shrew. Current and ongoing (human-caused) negative effects to the SMHM and its habitat in Suisun Marsh include the following.

- Habitat patches tend to be small, fragmented, and isolated from one another.
- Management wetland work activities, such as ground manipulation like ditching, discing, and burning.

- Mosquito abatement activities.
- Water quality considerations, especially Mercury contamination.
- Take by domestic cats from the Lawler Ranch subdivision and the release of feral cats.

The immediate and long-term effects of wetland management activities on the SMHM and Suisun shrew are not quantitatively known. However, management of the diked wetlands in Suisun Marsh has occurred for decades, and the SMHM continues to inhabit these wetlands. Further studies are necessary to determine if diked wetlands are used by the shrew, and if so, to assess the effects of diked wetland management on the shrew and devise actions that will provide seasonal waterfowl habitat, as well as habitat for the shrew.

Wetland losses through such actions such as diking, back-filling, and filling of tidal and coastal marshes have had the greatest negative effect on the shrew.

Conclusion and Determination

Until more is learned about habitat utilization by the Suisun shrew, it is difficult to assess the effects of Amendment Three actions on the shrew. The amendment is not expected to have substantial effects on the tidal wetlands, which is probably the primary habitat for the shrew in the marsh. If the shrew is a regular inhabitant of the managed wetlands, Amendment Three actions may have some negative effects, but they are not expected to be substantially greater than those already present under current management. The RGP allows much more habitat manipulation than is currently done in the marsh, and any increase above current levels will certainly be within the limits of the permit. Further studies are recommended to determine what habitats are inhabited by the shrew, how management activities affect the shrew, and how to successfully combine management for waterfowl habitat and maintenance of shrew habitat.

Greater Western Mastiff Bat, *Eumops perotis californicus*

Status

The greater western mastiff bat is classified as both a State and federal species of special concern.

Distribution

Greater western mastiff bats occur from the southwestern United States, south to central Mexico. Their distribution in California is not well understood, however, they are known to occur from San Francisco east to the Sierra Nevada and, from there, throughout the southern half of the State (Hall 1981). Recently western mastiff bats have also been observed a few miles from the Oregon border (Pierson 1998). Individuals appear to make local seasonal movements but are otherwise mostly resident throughout California (Jameson and Peeters 1988).

Habitat

The greater western mastiff bat is an uncommon species with a distribution likely dependent on significant rock features. A variety of habitats may be occupied, from desert scrub to the ponderosa pine belt. Greater western mastiff bats tend to roost in arid regions high above the ground, primarily in the crevices of vertical cliffs (usually granite or consolidated sandstone) and in broken terrain with exposed rock faces. They may also occur occasionally in high buildings, tree canopies and tunnels. Roost sites may change from season to season.

Foraging mostly occurs in broad open areas including dry desert washes, flood plains, chaparral, oak woodland, open ponderosa pine forest, giant sequoia and red fir forest, and grassland (Pierson 1998).

General Ecology

The greater western mastiff bat is North America's largest species of bat. Forming small colonies, both sexes remain together year-round (Jameson and Peeters 1986). They must drop from a height to take flight and are swift flyers but possess poor maneuverability. Greater western mastiff bats are active year-round, limited only when temperatures drop below about 5 °C (34 °F). Foraging takes place at high elevations (600 to 700 m) (Jameson and Peeters 1986) with distances from the colony sometimes exceeding 24 km (14.9 mi). Because foraging may last up to six or seven hours, night roosts are rarely used. Mating takes place in the later winter and early spring with one young born during the summer.

The species is declining, mostly due to loss of roost sites to urban and suburban expansion, dam development, and other activities that affect cliff habitat. Most known building colonies in the Los Angeles basin have been removed by pest control operations. Other potential threats include recreational climbing at roost sites and grazing and/or pesticide use in foraging areas.

General threats to greater western mastiff bats include activities that affect cliff faces and rock outcrops, and pest control operations or other disturbances where the animals occur in or around buildings.

Occurrence in the Project Area

The occurrence of greater western mastiff bats in the project area is not well understood. Cliff habitat is not available, however several stands of tall trees are present which may provide roost sites in some years. Because the project area lies within an extensive marsh where

insect concentration and abundance may be high, roosting bats would probably also use the area to forage. In addition, bats breeding elsewhere in the vicinity may visit the project area to forage. Those individuals making small migratory movements from outside the region could also potentially use the marsh for temporary foraging and roosting.

Project Impacts

The following actions included in Amendment Three are not expected to affect greater western mastiff bats.

- Salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Establishing criteria for September SMSCG operations.
- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repair.
- Water Manager Program.
- Portable Pumps Program.
- Drought Response Fund.
- Managed Wetlands Improvement Fund.
- 75/25 Cost-share Program.
- 50/50 Cost-share Program.
- Update Management Plans.
- Joint-use Facilities Program.

Though the project area contains potentially suitable breeding and foraging habitat for greater western mastiff bats, proposed actions are not expected to alter foraging efficiencies or roosting habitat and, therefore, are not expected to affect the bats.

Critical Habitat

There is no designated critical habitat for greater western mastiff bat in the project area.

Existing Environment and Cumulative Effects

Because the distribution of roosting or foraging greater western mastiff bats in Suisun Marsh is not well known, cumulative effects are difficult to estimate. Current on-going potential (human-caused) negative effects to greater western mastiff bats and their habitats in Suisun Marsh could include but may not be limited to the following.

- Degradation or loss of possible roost sites.
- Direct human disturbance.
- Pesticide exposure through the food web.

Conclusion and Determination

Amendment Three actions are not expected to negatively affect greater western mastiff bats.

Small-footed Myotis Bat, *Myotis ciliolabrum melanorhinus*

Status

The small-footed myotis is classified as a federal species of special concern.

Distribution

Four subspecies of small-footed myotis are recognized in the United States, one of which, *M. c. melanorhinus*, occurs in California (Hall 1981). Small-footed myotis are found on both sides of the Sierra Nevada below about 2,700 meters, with the exception of the coastal redwoods (Jameson and Peeters 1988).

Habitat

Small-footed myotis occur in deserts, chaparral, riparian zones, and western coniferous forest, most commonly above the pinon-juniper zone. Roosting occurs singly or in small groups. Habitats include caves, mines, buildings, cliff and rock crevices, and sometimes the undersides of tree bark and bridges. Foraging mostly takes place over water and in wooded areas.

General Ecology

Activity peaks about 30 minutes after emergence immediately following sunset and again two to three hours later. Small-footed myotis feed on a variety of small flying insects, including moths, flies, and beetles. Requiring more water than most other bats, they can be found drinking shortly after emergence.

Copulation takes place in the fall. Females form small maternity colonies and bear a single young sometime in May or June. The young are usually able to fly by mid August (Zeiner 1990). Small-footed myotis have a high cold tolerance but do hibernate from approximately November to March (Zeiner 1990). They may, however, awaken periodically during hibernation and move about in the roost.

General threats to small-footed myotis include mine closures, recreational caving, some forest management practices, activities that affect cliff faces and rock outcrops, and pest control operations or other disturbances where the animals occur in or around structures.

Occurrence in the Project Area

The presence of small-footed myotis in the project area is not well understood, however, because some breeding habitat is present there and elsewhere in the vicinity, small-footed myotis may inhabit the area during parts of the year. Roosting individuals would also be expected to forage in the project area due to the relatively high insect abundance normally associated with marshes. Additionally, during fall migratory movements small-footed myotis from elsewhere in the State might pass through the marsh during which time they may forage and roost in the project area.

Project Impacts

The following actions included in Amendment Three are not expected to affect small-footed myotis.

- Salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.

- Establishing criteria for September SMSCG operations.
- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repair.
- Water Manager Program.
- Portable Pumps Program.
- Drought Response Fund.
- Managed Wetlands Improvement Fund.
- 75/25 Cost-share Program.
- 50/50 Cost-share Program.
- Update Management Plans.
- Joint-use Facilities Program.

Though the project area contains potentially suitable breeding and foraging habitat for small-footed myotis, proposed actions are not expected to alter foraging efficiencies or roosting habitat and, therefore, are not expected to affect the bats.

Critical Habitat

There is no designated critical habitat for the small-footed myotis bat in the project area.

Existing Environment and Cumulative Effects

Because the distribution of roosting or foraging small-footed myotis in Suisun Marsh is not well known, cumulative effects are difficult to estimate. Current on-going potential (human-caused) negative effects to small-footed myotis and their habitats in Suisun Marsh could include but may not be limited to the following.

- Degradation or loss of possible roost sites.
- Direct human disturbance.
- Pesticide exposure through the food web.

Conclusion and Determination

Amendment Three actions are not expected to negatively affect small-footed myotis.

Long-eared Myotis Bat, *Myotis evotis*

Status

The long-eared myotis is classified as a federal species of special concern.

Distribution

Long-eared myotis are widespread in California with the exception of the southeastern desert and Central Valley (WBWG 1998). The species is, however, believed to be uncommon throughout most of its range (Zeiner 1990) and seldom occurs in large numbers (Jameson and Peeters 1986).

Habitat

Long-eared myotis are usually associated with coniferous forest, but also occur in semiarid shrubland, sage, chaparral, and agricultural areas. Roosting occurs under exfoliated tree bark, within hollow trees, caves, mines, cliff crevices, rock outcrops and sometimes in buildings and under bridges (WBWG 1998). Foraging habitat includes open and wooded areas.

General Ecology

Long-eared myotis are distinguished from the fringed myotis (*Myotis thysanodes*) by their long glossy black ears, and lack of distinct uropatagial fringe. Emergence usually occurs well after dark. Long-eared myotis are low flyers gleaning insects from tree foliage, rocks and off the ground.

Long-eared myotis are not believed to form maternity colonies (Jameson and Peeters 1986). A single young is born usually in June. Hibernation in the winter is presumed (WBWG 1998).

General threats to long-eared myotis include mine closures, recreational caving, some forest management practices, activities that affects cliff faces and rock outcrops, and pest control operations or other disturbances where the animals occur in or around structures.

Occurrence in the Project Area

The presence of long-eared myotis in the project area is not well understood, however, because some breeding habitat is present there and elsewhere in the vicinity, long-eared myotis may inhabit the area during parts of the year. Roosting individuals would also be expected to forage in the project area due to the relatively high insect abundances normally associated with marshes. Additionally, during fall migratory movements long-eared myotis from elsewhere in the State might pass through the marsh during which time they may forage and roost in the project area.

Project Impacts

The following actions included in Amendment Three are not expected to affect long-eared myotis.

- Salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Establishing criteria for September SMSCG operations.
- Morrow Island and Lower Joice Island fish screens.

- Roaring River Distribution System turnout repair.
- Water Manager Program.
- Portable Pumps Program.
- Drought Response Fund.
- Managed Wetlands Improvement Fund.
- 75/25 Cost-share Program.
- 50/50 Cost-share Program.
- Update Management Plans.
- Joint-use Facilities Program.

Though the project area contains potentially suitable breeding and foraging habitat for long-eared myotis, proposed actions are not expected to alter foraging efficiencies or roosting habitat and, therefore, are not expected to affect the bats.

Critical Habitat

There is no designated critical habitat for the long-eared myotis bat in the project area.

Existing Environment and Cumulative Effects

Because the distribution of roosting or foraging long-eared myotis in Suisun Marsh is not well known, cumulative effects are difficult to estimate. Current on-going potential (human-caused) negative effects to long-eared myotis and their habitats in Suisun Marsh could include but may not be limited to the following.

- Degradation or loss of possible roost sites.
- Direct human disturbance.
- Pesticide exposure through the food web.

Conclusion and Determination

Amendment Three actions are not expected to negatively affect long-eared myotis.

Fringed Myotis Bat, *Myotis thysanodes*

Status

The fringed myotis is classified as a federal species of special concern.

Distribution

Fringed myotis occur throughout California except for the Central Valley and Colorado and Mojave deserts (Zeiner 1990).

Habitat

Habitats most commonly include oak and juniper woodlands, but also hot desert scrubland, grassland, xeric woodland, sage-grass steppe, mesic old growth forest, and multi-age subalpine coniferous and mixed-deciduous forest (WBWG 1998).

Maternity and night roosting habitat includes caves, buildings, underground mines, rock crevices and cliff faces, bridges and trees, including giant sequoias (WBWG 1998). Hibernating colonies have only been observed in buildings and underground mines.

General Ecology

Fringed myotis occur in colonies numbering from approximately 10 to 2,000 individuals. Copulation takes place in the fall with delayed ovulation, implantation, and fertilization occurring in early spring. Gestation is 55 days. One young is born in late June to early July (Jameson and Peeters 1986). The young are capable of flight at 16 days of age and are fully volant by 20 days (WBWG 1998). Prey includes beetles, moths, spiders, crickets, harvestmen, and a variety of hemipterans (WBWG 1998). Extensive migration is not believed to occur.

Roosting fringed myotis are easily disturbed. General threats to the species include mine closures, recreational caving, some forest management practices, activities that affects cliff faces and rock outcrops, and pest control operations or other disturbances where the animals occur in or around structures.

Occurrence in the Project Area

The presence of fringed myotis in the project area is not well understood, however, because some breeding habitat is present there and elsewhere in the vicinity, fringed myotis may inhabit the area during parts of the year. Roosting individuals would also be expected to forage in the project area due to the relatively high insect abundances normally associated with marshes. Additionally, during fall migratory movements fringed myotis from elsewhere in the State might pass through the marsh during which time they may forage and roost in the project area.

Project Impacts

The following actions included in Amendment Three are not expected to affect fringed myotis.

- Salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Establishing criteria for September SMSCG operations.

- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repair.
- Water Manager Program.
- Portable Pumps Program.
- Drought Response Fund.
- Managed Wetlands Improvement Fund.
- 75/25 Cost-share Program.
- 50/50 Cost-share Program.
- Update Management Plans.
- Joint-use Facilities Program.

Though the project area contains potentially suitable breeding and foraging habitat for fringed myotis, proposed actions are not expected to alter foraging efficiencies or roosting habitat and, therefore, are not expected to affect the bats.

Critical Habitat

There is no designated critical habitat for the fringed myotis bat in the project area.

Existing Environment and Cumulative Effects

Because the distribution of roosting or foraging fringed myotis in Suisun Marsh is not well known, cumulative effects are difficult to estimate. Current on-going potential (human-caused) negative effects to fringed myotis and their habitats in Suisun Marsh could include but may not be limited to the following.

- Degradation or loss of possible roost sites.
- Direct human disturbance.
- Pesticide exposure through the food web.

Conclusion and Determination

Amendment Three actions are not expected to negatively affect fringed myotis.

Long-legged Myotis Bat, *Myotis volans*

Status

The long-legged myotis is classified as a federal species of special concern.

Distribution

Long-legged myotis are distributed throughout California except for the Central Valley and Colorado and Mojave deserts. Most, however, occur above approximately 1,200 meters (4,000 feet) (Zeiner 1990).

Habitat

Long-legged myotis are most commonly found in coniferous forests, but may also occur seasonally in riparian zones and deserts (WBWG 1998). Roost sites are typically located in abandoned buildings, cliff crevices and in tree hollows and under exfoliating bark. Hibernacula include caves and mines.

General Ecology

Long-legged myotis emerge early before dark, probably to forage on early-flying nocturnal insects (Jameson and Peeters 1986). They become most active three to four hours after sunset and remain active throughout the night. Flight is rapid and direct. Feeding occurs in and around tree canopies and includes moths and other soft bodied insects (WBWG 1998). Copulation occurs in autumn with one young born between approximately May and August.

General threats to the species include mine closures, recreational caving, some forest management practices, activities that affects cliff faces and rock outcrops, and pest control operations or other disturbances where the animals occur in or around structures.

Occurrence in the Project Area

The presence of long-legged myotis in the project area is not well understood, however, because some breeding habitat is present there and elsewhere in the vicinity, long-legged myotis may inhabit the area during parts of the year. Roosting individuals would also be expected to forage in the project area due to the relatively high insect abundances normally associated with marshes. Additionally, during fall migratory movements long-legged myotis from elsewhere in the State might pass through the marsh during which time they may forage and roost in the project area.

Project Impacts

The following actions included in Amendment Three are not expected to affect long-legged myotis.

- Salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Establishing criteria for September SMSCG operations.
- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repair.
- Water Manager Program.
- Portable Pumps Program.

- Drought Response Fund.
- Managed Wetlands Improvement Fund.
- 75/25 Cost-share Program.
- 50/50 Cost-share Program.
- Update Management Plans.
- Joint-use Facilities Program.

Though the project area contains potentially suitable breeding and foraging habitat for long-legged myotis, proposed actions are not expected to alter foraging efficiencies or roosting habitat and, therefore, are not expected to affect the bats.

Critical Habitat

There is no designated critical habitat for the long-legged myotis bat in the project area.

Existing Environment and Cumulative Effects

Because the distribution of roosting or foraging long-legged myotis in Suisun Marsh is not well known, cumulative effects are difficult to estimate. Current on-going potential (human-caused) negative effects to long-legged myotis and their habitats in Suisun Marsh could include but may not be limited to the following.

- Degradation or loss of possible roost sites.
- Direct human disturbance.
- Pesticide exposure through the food web.

Conclusion and Determination

Amendment Three actions are not expected to negatively affect long-legged myotis.

Yuma Myotis Bat, *Myotis yumanensis*

Status

The Yuma myotis is classified both as a federal and State species of special concern.

Distribution

Six subspecies of Yuma myotis are recognized. Four of these (*M. y. saturatus*, *M. y. oxalis*, *M. y. sociabilis*, *M. y. yumanensis*) occur in California (Hall 1981). Yuma myotis occur throughout California except in the Mojave and Colorado deserts of southeastern California. They occupy a variety of habitats below about 3,300 meters (11,000 feet) but are rare above approximately 2,560 meters (8,000 feet) (Zeiner 1990).

Habitat

Yuma myotis inhabit riparian zones, arid scrublands, deserts, and open forests and woodlands. Roosts may occur in buildings, mines, caves or crevices (Zeiner 1990).

General Ecology

Yuma myotis emerge shortly after sunset and feed mostly on aquatic emergent insects. Hibernation occurs in some portions of the species range where short migrations may be made from higher elevations to preferred hibernacula. Large maternity colonies of several thousand may form in buildings, caves, mines and bridges. Mating occurs in the fall with one young born between approximately late May to mid-June. Yuma myotis may roost with other species including pallid and Mexican freetailed bats. Individuals are known to have lived as long as 8.8 years (Zeiner 1990).

Yuma myotis strongly resemble the little brown myotis and hybridization may occur between members of the species where their ranges overlap in the mid- to northwestern, northeastern, and eastern parts of California.

General threats include mine closures, recreational caving, some forest management practices, activities that affects cliff faces and rock outcrops, and pest control operations or other disturbances where the animals occur in or around structures.

Occurrence in the Project Area

The presence of Yuma myotis in the project area is not well understood, however, because some breeding habitat is present there and elsewhere in the vicinity, Yuma myotis may occur during parts of the year. Roosting individuals are also expected to forage in the project area due to the relatively high insect abundance normally associated with marshes. Additionally, during fall migratory movements, Yuma myotis from elsewhere in the State probably pass through the marsh during which time they may forage and roost in the project area.

Project Impacts

The following actions included in Amendment Three are not expected to affect Yuma myotis.

- Salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.

  Criteria for September SMSCG Operations.

Morrow Island and Lower Joice Island fish screens.

Roaring River Distribution System turnout repair.

- Water Manager Program.
- Portable Pumps Program.
- Drought Response Fund.
- Managed Wetlands Improvement Fund.

  75/25 Cost-share Program.

  50/50 Cost-share Program.

- Update Management Plans.
- Joint-use Facilities Program.

Though the project area contains potentially suitable breeding and foraging habitat for long-legged myotis, proposed actions are not expected to alter foraging efficiencies or roosting habitat and, therefore, are not expected to affect the bats.

Critical Habitat

There is no designated critical habitat for the Yuma myotis bat in the project area.

Existing Environment and Cumulative Effects

Because the distribution of Yuma myotis in Suisun Marsh is not well known, cumulative effects are difficult to estimate. Current on-going potential (human-caused) negative impacts to Yuma myotis and their habitat in Suisun Marsh could include but may not be limited to the following.

- Degradation or loss of possible roost sites.
- Direct human disturbance.
- Pesticide exposure through the food web.

Conclusion and Determination

Amendment Three actions are not expected to negatively affect Yuma myotis.

Townsend's Big-eared Bat, *Corynorhinus townsendii*

Status

The Townsend's big-eared bat is classified both as a federal and State species of special concern.

Distribution

Townsend's big-eared bats are known to occur along the Pacific Coast from British Columbia throughout California and south to Mexico (Hall 1981), however, their distribution in California is poorly understood (Zeiner 1990; Pierson 1998).

Habitat

Townsend's big-eared bats mostly inhabit mesic areas but will use other habitat types with the exceptions of those in subalpine and alpine regions. Elevations of occurrence range from sea level to approximately 3,300 meters. Habitats include coniferous and mixed mesophytic forests, deserts, native prairie, riparian and coastal zones and agricultural areas (WBGB 1998).

General Ecology

In California, two subspecies (*C. t. townsendii* and *C. t. pallescens*) are recognized (Handley 1959). Extensive zones of integration between these have been observed west of approximately 118° west longitude where distinguishing the two subspecies is difficult (Pierson 1998). Residency in California is year-round. (Hall 1981).

Townsend's big-eared bats are semi-colonial, forming maternity colonies but sometimes hibernating singly. Roosting occurs in caves and cave-like structures such as tunnels, mines and bridges. Maternity colonies have been observed in mines and attics.

Peak activity occurs in the late evening. Thought to be a moth specialist, Townsend's big-eared bats forage along habitat edges gleaning insects from shrubs and trees. Hibernation occurs from approximately October to April. Males are solitary in the spring during which time the females form maternity colonies. Reproduction occurs before hibernation with one offspring born sometime in May or June. The young can fly by three weeks of age and are weaned at about six weeks.

Though distributed throughout California, the numbers of Townsend's big-eared bats are believed to be declining rapidly due to human disturbance and loss of suitable roosting habitat (Zeiner 1990; Pierson 1998). Overall decline has been estimated at about 55% (Pierson 1998). Townsend's big-eared bats demonstrate strong site fidelity if undisturbed but because of their extreme sensitivity to disturbance, many of the nursery colonies in California' limestone caves and mines have been severely reduced in number or extirpated.

General threats to the species include mine closures, recreational caving, some forest management practices, activities that affect cliff faces and rock outcrops, and pest control operations or other disturbances where the animals occur in or around structures.

Occurrence in the Project Area

The occurrence of Townsend's big-eared bats in the project area is not well understood, however, because some breeding habitat is present there and elsewhere in the vicinity, Townsend's big-eared bats could potentially inhabit the area. Roosting individuals would also be

expected to forage in the project area due to the relatively high insect abundances normally associated with marshes.

Project Impacts

The following actions included in Amendment Three are not expected to affect Townsend's big-eared bat.

- Salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Criteria for September SMSCG Operations.
- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repair.
- Water Manager Program.
- Portable Pumps Program.
- Drought Response Fund.
- Managed Wetlands Improvement Fund.
    - 75/25 Cost-share Program.
    - 50/50 Cost-share Program.
- Update Management Plans.
- Joint-use Facilities Program.

Though the project area contains potentially suitable breeding and foraging habitat for Townsend's big-eared bats, proposed actions are not expected to alter foraging efficiencies or roosting habitat and, therefore, are not expected to affect the bats.

Critical Habitat

There is no designated critical habitat for the Townsend's big-eared bat in the project area.

Existing Environment and Cumulative Effects

Because the distribution of roosting or foraging Townsend's big-eared bats in Suisun Marsh is not well known, cumulative effects are difficult to estimate. Current on-going potential (human-caused) negative impacts to Townsend's big-eared bat and their habitat in Suisun Marsh could include but may not be limited to the following.

- Degradation or loss of possible roost sites.
- Direct human disturbance.
- Pesticide exposure through the food chain.

Conclusion and Determination

Amendment Three actions are not expected to negatively affect Townsend's big-eared bat.

Chapter 6
BIRDS

Tricolored Blackbird, *Agelaius tricolor*

Status

The tricolored blackbird population has declined since at least the 1930s, mostly due to habitat loss (Neff 1937; DeHaven and others 1975; Bowen and others 1992; Hamilton and others 1995, 1997; Cook and Hamilton forthcoming). Thought to be nearing extinction in the early 1990s, the species became a candidate for listing under the California Endangered Species Act and a proposed candidate under the federal Endangered Species Act. Extensive surveys during the 1992 breeding season, however, demonstrated a larger population than was thought (Bowen and others 1992), prompting withdrawal of listing efforts. Data from ongoing population monitoring since that time indicates that the species' population continues to decline. The tricolored blackbird is presently classified as a California State Species of Special Concern and a federal Migratory Non Game Bird of Management Concern.

Distribution

The tricolored blackbird is a California endemic. Small colonies have historically been observed in northern Baja California and southern Oregon (Neff 1937), however, none have been observed recently in Baja and only occasionally are small colonies observed in southern Oregon (Hamilton and others 1995; Hamilton 1998). Most breeding occurs in California's Central Valley from April through July (Neff 1937; DeHaven 1975; Bowen and others 1992; Hamilton and others 1995). A first breeding effort occurs primarily in the San Joaquin Valley south to Kern County and separately in southern Sacramento County (Bowen and others 1992; Hamilton and others 1995; Cook and Hamilton forthcoming). An itinerant effort following this occurs in other portions of the Sacramento Valley, including primarily Glenn and Colusa counties (Hamilton 1998). A large portion of the population is believed to overwinter in the Sacramento-San Joaquin Delta (DeHaven and others 1975) (Cook, personal observation; Hamilton and Palaroni, personal communications, see "Notes").

Habitat

Traditional nesting habitat consists of inundated dense cattail (*Typha* spp.) and hardstem bulrush (*Scirpus acutus*) (Neff 1937). In recent years, the occurrence of colonies in upland habitats has increased substantially, probably in response to loss of more traditional sites. Most upland nesting habitat consists of agricultural grain fields in the San Joaquin Valley and thickets of Himalaya blackberry (*Rubus procerus*) in the northern San Joaquin Valley and Sacramento Valley (Bowen and others 1992; Hamilton and others 1995; Cook and Hamilton forthcoming). Other upland nesting habitats include patches of thistle (*Cirsium* spp.) and stinging nettle (*Urtica dioica*) (Neff 1937; Beedy 1991; Bowen and others 1992; Hamilton and others 1995). Foraging mostly occurs in upland habitats, especially in dry grassland and pastures. Heavily grazed fields are usually not suitable foraging habitat for tricolored blackbirds (Bowen and others 1992; Hamilton and others 1995). Winter foraging habitat consists of upland grassy areas and

shallow wetlands. Winter roosting habitat consists mostly of dense deep water marshes and nearby trees.

Habitat occurring within Suisun Marsh that may be used by breeding and roosting tricolored blackbirds mostly includes the dense cattail and bulrush marshes found throughout the marsh. Foraging habitat consists primarily of the grassy and herbaceous uplands in the area.

General Ecology

Tricolored blackbirds resemble redwing blackbirds (*Agelaius phoeniceus*) in appearance but display very different breeding behaviors. Whereas the redwing blackbird is strongly territorial during the breeding season, the tricolored blackbird is intensely colonial (Neff 1937; DeHaven 1975). Habitat selection is most likely primarily a function of insect densities. Colonies, therefore, may occur regularly in some locations but sporadically in others. Breeding tends to be highly synchronized within colonies where active nest densities may reach three or more per square meter. The breeding cycle of tricolored blackbirds is rapid and may be completed in as little as 40 days. Clutch size is typically three or four eggs. Eggs are laid asynchronously and hatch approximately one day apart following an incubation period of 13 days (Bowen and others 1992). The young fledge at about ten days of age. Colonies range in size from less than one hundred to tens of thousands of breeding adults (DeHaven 1975; Bowen and others 1992; Hamilton and others 1995; Cook and Hamilton forthcoming).

During the nonbreeding season, tricolored blackbirds forage on insects, grains, and seeds. When provisioning offspring, however, adults forage almost entirely on insects. Large numbers of grasshoppers may be taken in later spring and summer months. Because tricolored blackbirds are colonial, they require concentrated food resources within a manageable commuting distance from the colony. The size of the foraging arena, therefore, varies with colony size and insect abundance. Foraging arenas of successful colonies may range in size from a radius of two to three miles to as many as eight miles (Bowen and others 1992; Hamilton and others 1995; Cook and Hamilton forthcoming).

Significant causes of nestling mortality include predation and starvation (Bowen and others 1992; Hamilton and others 1995; Cook and Hamilton forthcoming). Predation may be almost complete in some marsh nesting colonies where the young are taken largely by herons. In contrast, the heavy armoring of the Himalaya blackberry protects nesting tricolored blackbirds from larger avian and mammalian predators. Mean reproductive success rates among colonies in Himalaya blackberry have been the highest observed in recent years. Juvenile and annual adult survivorship is unknown.

Occurrence in the Project Area

Breeding tricolored blackbirds have not been observed in the Suisun Marsh or nearby Delta areas, however, the region has also not been well surveyed. Tricolored blackbirds are observed in nearby areas of the Delta as early as July and may be fall breeders in some years. The project area has the potential, therefore, to support breeding tricolored blackbirds.

Tricolored blackbirds overwinter in the Sacramento-San Joaquin Delta, including the Suisun Marsh (DeHaven and others 1975) (Cook, personal observation; Hamilton and Palaroni, personal communications, see “Notes”). Large numbers observed there indicate the region may be especially important for overwintering adults and juveniles. Surveys are needed to better determine the distribution of tricolored blackbirds in Suisun Marsh.

Project Impacts

The following Amendment Three Actions are not expected to affect the tricolored blackbird.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Establishing criteria for September SMSCG Operations.
- Morrow Island and Lower Joice Island fish screens (provided active colonies are not located at the sites during installation).
- Roaring River Distribution System turnout repair (provided active colonies are not located at the site during repairs).
- Water Manager Program.
- Portable Pumps Program.

The following Amendment Three Actions could affect the tricolored blackbird.

Drought Response Fund

This action would provide funds for management activities such as discing, creation of V-ditches, and operation of portable pumps. Activities such as ditching and discing in or adjacent to a breeding tricolored blackbird colony could cause nesting failure and colony abandonment. Large-scale burning and discing could reduce the food base and foraging efficiency of breeding tricolored blackbirds. Water level changes could affect tricolored blackbirds by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of nest substrates. However, there should be little or no effect to tricolored blackbirds provided they are not present during project activities.

Large-scale burning and discing during winter months could also reduce the foraging efficiency of juvenile and adult tricolored blackbirds. Smaller scale operations should have little or no effect on tricolored blackbirds.

Managed Wetlands Improvement Fund

75/25 Cost-share Program. This program will replace or improve drainage facilities and allow for better control of hydroperiod and leaching cycles. Construction activities occurring in or adjacent to active breeding colonies could cause nest failure and colony abandonment. Water level changes could affect tricolored blackbirds by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of nest substrates. However, there should be little or no effect to tricolored blackbirds provided they are not present during project activities.

50/50 Cost-share Program. This program will facilitate the construction of water deliver systems such as ditches in the managed wetlands. Construction activities occurring in or adjacent to active breeding colonies would cause nest failure and colony abandonment. However, there should be little or no effect to tricolored blackbirds provided they are not present during project activities.

Updating Management Plans

This action will fund efforts to write new management plans for private ownerships in the marsh. While this action in itself will not cause impacts, activities recommended in the plans may result in increased activities like ditching, discing, and leach cycles. Decreases in soil

water salinity should have no affect on tricolored blackbirds. Construction activities occurring in or adjacent to active breeding colonies could cause nesting failure and colony abandonment. Water level changes could affect tricolored blackbirds by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of nest substrates. However, there should be little or no effect to tricolored blackbirds provided they are not present during project activities.

Joint-use Facilities Program

This action incorporates many of the above-mentioned management activities and facilities construction into a plan for the joint-use of facilities by neighboring property owners. Construction activities occurring in or adjacent to a breeding colony could affect tricolored blackbirds directly by causing nesting failure or colony abandonment. Large scale discing could also affect tricolored blackbirds during the nesting season by reducing prey availability. Water level changes could affect tricolored blackbirds by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of nest substrates. However, there should be little or no effect to tricolored blackbirds provided they are not present during project activities.

Because tricolored blackbirds are colonial, the potential for impacts can be high. Impacts to tricolored blackbirds would include the direct disturbance of nesting colonies and/or associated foraging habitat. Activities, whereby people or machinery approach active colonies, may also increase access by predators possibly causing abandonment. Plowing, discing, pesticide applications, or other activities that reduce insect availability within the foraging arena, could reduce foraging efficiency of breeding birds.

Critical Habitat

There is no designated critical habitat for the tricolored blackbird in the project area.

Existing Environment and Cumulative Effects

Because the presence of nesting tricolored blackbirds in Suisun Marsh is uncertain, as is the distribution of the wintering population, cumulative effects are difficult to estimate. Large-scale winter habitat changes would have the potential to significantly affect the species either positively or negatively. Current ongoing (human-caused) negative impacts to the tricolored blackbird and its habitat in Suisun Marsh include, but are not limited to, the following the following.

- Possible direct human disturbance, including removal of vegetative nest substrate and water level changes that inundate breeding colonies or increase predation.

- Temporary loss of foraging habitat to discing or burning. Because tricolored blackbirds occur in the Suisun Marsh during fall and winter months, such operations at that time may have some, but probably not significant, impacts to the species unless they involved substantial and important foraging areas.

Conclusion and Determination

Because most of the population probably winters in the Sacramento-San Joaquin Delta, including Suisun Marsh, wide-scale removal of foraging habitat could affect overwinter survivorship. Because most management activities would occur during spring and summer months, there may be little or no impacts to tricolored blackbirds provided breeding does not occur in Suisun Marsh. Should breeding occur

in Suisun Marsh, management activities that would directly affect reproductive success should be postponed until offspring are fully fledged. Surveys for sensitive species, including tricolored blackbird would be conducted prior to SMPA-funded work activities being conducted.

Western Burrowing Owl, *Athene cunicularia hypugea*

Status

The western burrowing owl (*Athene cunicularia hypugea*) is classified as a State and federal Species of Concern.

Distribution

The western burrowing owl is found in western North America from Canada to Mexico, and east from Texas to Louisiana. In certain areas of its range, it is migratory; this includes the northern areas of the Great Plains and Great Basin. Although the burrowing owls in northern California are thought to migrate, owls within central and southern California are predominantly nonmigratory.

Habitat

Burrowing owls are found in open, dry grasslands, agricultural and range lands, and desert habitats often associated with burrowing animals. They can also inhabit grass, forb, and shrub stages of pinyon and ponderosa pine habitats. They can be found at elevations ranging from 200 feet below sea level to 9,000 feet. In California, the highest elevation where this species is found is 5,300 feet in Lassen County. The owl commonly perches on fence posts or on top of mounds outside its burrow. These owls can be found at the margins of airports and golf courses and in vacant urban lots. They are active day and night, but are usually less active in the peak of the day.

General Ecology

The western burrowing owl is a small ground-dwelling owl with a round head that lacks the tufts of feathers which are often referred to as ear tufts. It has white eyebrows, yellow eyes, and long stilt-like legs. The owl is sandy colored on the head, back, and upper parts of the wings and white-to-cream with barring on the breast and belly. Unlike most owls, the male is slightly larger than the female and the females are usually darker than the males.

Burrowing owls tend to be opportunistic feeders. Large arthropods, mainly beetles and grasshoppers, comprise a large portion of their diet. Small mammals, especially mice, rats, gophers, and ground squirrels, are also important food items. Other prey animals include reptiles and amphibians, scorpions, young cottontail rabbits, bats, and birds, such as sparrows and horned larks. Consumption of insects increases during the breeding season. The burrowing owl hovers while hunting, similar to an American kestrel (*Falco sparverius*). After catching its prey, it returns to a perch on a fence post or the ground. Burrowing owls are primarily crepuscular (active at dusk and dawn), but will hunt throughout a 24-hour period.

As their name suggests, burrowing owls nest in burrows in the ground, often in old ground squirrel burrows or badger dens. They can dig their own burrows, but prefer deserted excavations of other animals. They are also known to use artificial burrows.

Their nesting season begins in late March or April. The owls often line their nest with an assortment of dry materials. Six to eleven eggs are laid; the average number of eggs is seven to nine. Incubation lasts 28 to 30 days and is performed by the female only. The male cares for the young while still in the nest. At 14 days of age, the young may be seen roosting at the entrance to the burrow, waiting for the adults to return with food. The young leave the nest at about 44 days and begin chasing living insects when they are 49 to 56 days old.

Occurrence in the Project Area

In the Suisun Marsh, burrowing owls have been sighted in upland areas near Collinsville, and in the upland area at Rush Ranch. If burrowing owls populations exist in the Suisun Marsh, it is likely that they occur near upland areas around the margins of the marsh where ground squirrels and associated burrows may occur.

Project Impacts

The following Amendment Three actions are not expected to affect the western burrowing owl.

- Making salinity Standards consistent with the 1995 and 1998 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Establishing criteria for September SMSCG operations.
- Updating management plans.
- Drought Response Fund.
- Portable Pumps Program.
- Water Manager Program.
- Roaring River Distribution System turnout repairs.
- Lower Joice Island fish screen.

Managed Wetlands Improvement Fund

There are no anticipated negative effects to western burrowing owl from the continued implementation of the 75/25 Cost-share Program. Except for the coring of existing interior and exterior levees which may have rodent holes, the actions included in the proposed 50/50 Cost-share Program are not expected to affect this species. It is possible that burrowing owls could be displaced during levee coring activities, but unlikely. In the Suisun Marsh the burrowing mammals primarily responsible for levee damage are muskrats (*Ondatra zibetlea*) and beavers (*Castor canadensis*). The burrows of these aquatic species would not be suitable for burrowing owls, thus these activities would not affect them. Ground squirrel (*Spermophius beecheyl*), burrows are associated with upland areas on the periphery of the marsh and thus are only a small contributor to the levee damage within the managed wetlands. Ground squirrel burrows would be repaired promptly to prevent levee instability, thus leaving little opportunity for burrowing owls to become established.

Existing Facilities Operation and Maintenance

The operation of the SMSCG, the Lower Joice Island fish screen, the Cygnus Unit, Goodyear Slough Outfall, and the Roaring River Distribution System turnout repairs are not anticipated to affect the western burrowing owl. The operation of the Morrow Island Distribution System (MIDS), the Roaring River Distribution System (RRDS) will not affect the western burrowing owl, but the maintenance of the levee systems of these water conveyance facilities could affect burrowing owls, if present. Animal burrows in water control levees are a threat to levee stability and commonly lead to levee failure if left unrepaired. To date, there is no record of burrowing owl presence at these sites, and it is unlikely that levees with animal burrows would be left unrepaired long enough to allow burrowing owls to establish use.

Joint-use Facilities Program

There are no anticipated negative effects to the western burrowing owls from the implementation of the Joint-use Facilities Program activities, except for coring of existing interior and

exterior levees as described previously under the Managed Wetlands Improvement Fund.

Critical Habitat

There is no designated critical habitat for the western burrowing owl in the project area.

Existing Environment and Cumulative Effects

There are current and ongoing environmental considerations which may be affecting the western burrowing owls the following.

- Loss of open space areas (pastures and uplands) to agricultural, urban, and industrial development.

- The ongoing control of burrowing animals such as ground squirrels, through the use of poison baits and trapping.

- The loss of individual owls to vehicle strikes when foraging at night or migrating.

Conclusion and Determination

None of the Amendment Three actions are anticipated to affect western burrowing owls in the Suisun Marsh, except for minimal potential effects from the coring of rodent holes in levees. In the Suisun Marsh muskrats and beavers are the most common burrowing animals causing problems to levee stability. Both of these species are primarily aquatic and would not provide suitable burrows for burrowing owls, but in upland areas where ground squirrels occur suitable burrows could exist. However, it is unlikely that burrowing owls would establish use in these areas, prior to emergency repairs being conducted to burrows in the levee system.

American Bittern, *Botaurus lentiginosus*

Status

The American Bittern is on the State Partners in Flight Watch List and is a federal Migratory Non Game Bird of Management Concern.

Distribution

Breeding occurs in North America from Canada south to the central United States where it becomes discontinuous (Hancock and Kushlan 1984). Local nesting also occurs in Texas, Louisiana, and rarely in Florida and Mexico (Banks and Dickerman 1978, as cited in Hancock and Kushlan 1984). The American bittern has declined as a breeding bird throughout central and southern California coastal and interior marshes due to loss of freshwater wetland habitat (Small 1994). Currently the species is reported as an uncommon resident in the Sacramento Valley marshes, increasing in number somewhat during fall and winter (Small 1994).

Habitat

American bitterns are a bird of fresh and brackish water marshes (Hancock and Kushlan 1984; Small 1994). Preferred habitats are bulrush (*Scirpus* spp.) and cattail (*Typha* spp.), but uplands containing tall vegetation may also be used provided there is adequate cover. Protected and managed areas with open water are very important to wintering American bitterns (Root 1988). Foraging usually takes place in shallow fresh water surrounded by tall vegetation, but sometimes also in meadows.

Habitat occurring within Suisun Marsh that may be used by breeding and foraging American bitterns mostly includes dense cattail and bulrush marshes. Shallow flooded areas and moist grassy and herbaceous uplands may also serve as foraging habitat.

General Ecology

American bitterns are territorial and solitary breeders (Hancock and Kushlan 1984). Nesting occurs in deep water marshes, where nests are constructed of marsh plants and placed at or just above the water's surface. Nests may also be constructed on dry ground provided dense cover is available. Approximately four to five eggs are laid, but sometimes as many as six or seven. Incubation begins with the first egg and lasts approximately 28 to 29 days. The young fledge at about 14 days of age. Length of parental dependency is unknown.

American bitterns are also solitary foragers, either standing and waiting for prey to approach or slowly walking and searching (Hancock and Kushlan 1984). Their diet is diverse but fish are probably very important. Other food items include amphibians, reptiles, insects, crayfish, and small mammals, including ground squirrels, mice and rats (Hancock and Kushlan 1984).

Occurrence in the Project Area

The frequency, number and distribution of American bittern occurring in the Suisun Marsh is not well known because surveys have not been conducted there. Suitable nesting and foraging habitat is available to breeding American bitterns in and around the project area, as is winter habitat.

Project Impacts

The following actions included in Amendment Three are not expected to affect American bitterns.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Establishing criteria for September SMSCG Operations.
- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repair.
- Water Manager Program.
- Portable Pumps Program.

The following actions included in Amendment Three could affect American bitterns.

Drought Response Fund

This action would provide funds for management activities such as discing and creation of V-ditches. Activities such as discing and ditching could affect American bitterns by destroying nests.

Managed Wetlands Improvement Fund

75/25 Cost-share Program

This program will replace or improve drainage facilities and allow for better control of hydroperiod and leaching cycles. Construction activities could affect American bitterns directly by destroying nests should they occur in the project area. Water level changes could affect American bitterns by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of nest substrates. Temporary water level changes may also affect the foraging efficiency of breeding birds

50/50 Cost-share Program

This program will facilitate the construction of water delivery systems such as ditches in the managed wetlands. Construction activities could affect American bitterns directly by destroying nests if present at the project site. Water level changes could affect American bitterns by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of nest substrates. Temporary water level changes could also affect foraging efficiency of breeding birds.

Updating Management Plans

This action will fund efforts to write new management plans for private ownerships in the marsh. While this action in itself will not cause impacts, activities recommended in the plans may result increased activities like ditching, discing and leach cycles. Because American bitterns forage in both freshwater and brackish marshes, decreases in soil water salinity should not affect them. Ditching and discing could directly affect American bitterns by destroying nests if present in the project area. Water level changes could affect American bitterns by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of nest substrates.

Joint-use Facilities Program

This action incorporates many of the above-mentioned management activities and facilities construction into a plan for the joint use of facilities by neighboring property owners. Activities may include construction and maintenance of ditches, improvements to water control structures and common levee coring. Activities such as ditching and discing could directly affect American bitterns by destroying nests should they be present in the project area. Water level changes could affect American bit-

terns by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of nest substrates.

Potential project impacts to American bitterns would include the temporary removal of marsh vegetation and destruction of nests in the project area due to construction activities and/or water level changes.

Critical Habitat

There is no designated critical habitat for the American bittern in the project area.

Existing Environment and Cumulative Effects

Current on-going (human-caused) negative impacts to American bitterns and their habitat in Suisun Marsh potentially include but are not limited to the following.

- Direct human disturbance, including removal of vegetative nest substrate and water level changes that might directly affect breeding success.
- Decreased foraging efficiency from temporary loss of shallow water foraging habitat due to drainage operations.
- Potential loss of densely vegetated habitat.

Conclusion and Determination

If American bitterns are in the project area, Amendment Three actions have the potential to affect the species through direct destruction of nests, possible decrease in foraging efficiency, loss of foraging habitat through drainage operations, and possible nesting failure resulting from water level changes. Delaying activities that would negatively affect American bitterns until young are flighted would substantially reduce impacts, as would pre-project surveys.

Aleutian Canada Goose, *Branta canadensis leucoparela*

Status

The Aleutian Canada goose was federally listed as endangered on 11 March 1967 (32 FR 4001), and reclassified as threatened on 12 December 1990 (55 FR 51112). A detailed account of the taxonomy, ecology, and biology of the Aleutian Canada goose is presented in the approved recovery plan for this species (USFWS 1991).

Distribution

The Aleutian Canada Goose is thought to have historically nested on maritime islands from the Alaska Peninsula, westward along the Aleutian Chain, to the Commander and Kuril islands of Asia. When it was listed in 1967, the Aleutian Canada goose was only known to nest on Buldir Island in the western Aleutian Islands. Subsequently, remnant flocks have been found on Chagulak Island in the eastern Aleutians and Kaliktagik in the Semidi Islands. Recovery efforts in the breeding range presently focus on the Semidi Islands, and the western and eastern Aleutian Island flocks. The geese nest on treeless islands in areas densely vegetated by grasses, sedges, and ferns, often where there is no source of fresh water.

Most Aleutian Canada geese winter in California. They arrive on the wintering grounds in early to mid-October. Some geese stop in the Crescent City area in northwest California but most continue on to the vicinities of Colusa in the Sacramento Valley and Modesto in the northern San Joaquin Valley. By mid-December the majority of the population is near Modesto. Small numbers of Aleutian Canada geese also frequently winter near El Sobrante in north San Francisco Bay and near Crescent City. Most of the population stages near Crescent City on the northward migration although several thousand birds are now using pasture land in south coastal Oregon for several weeks in the spring. The small population of geese that breeds in the Semidi Islands winters exclusively in coastal Oregon near Pacific City.

Habitat

The Aleutian Canada goose's major migration and wintering areas include coastal areas of Oregon and northern California and California's Sacramento and San Joaquin valleys. The Aleutian Canada goose migrates between breeding and wintering areas from August to March. Wintering and migrating Aleutian geese forage in harvested corn fields, newly planted or grazed pastures, or other agricultural fields (for example, rice stubble and green barley). Lakes, reservoirs, ponds, large marshes, and flooded fields are used for roosting and loafing (Grinnell and Miller 1944). In winter, Aleutian geese exhibit a crepuscular foraging pattern, roosting in large flocks during most of the day and night and flying to and from foraging areas during the hours around dawn and dusk.

General Ecology

The decline in numbers of Aleutian geese and the reduction of their breeding range is attributed to predation by arctic fox (*Alopex lagopus*), which were introduced on many Aleutian islands by fur traders from 1836 to 1930 (55 FR 239). The role of migration and wintering habitat loss in the historical decline of Aleutian geese is not well understood. Changing land use practices, including the conversion of cropland and pastures to housing and other urban development, and sport and subsistence

hunting likely contributed to the historical decline (USFWS 1991).

The approved recovery plan describes three criteria to be achieved to consider delisting the Aleutian Canada goose. These criteria include (1) a minimum overall population of 7,500 individuals and a demonstrated upward trend in population numbers; (2) a minimum nesting population of 50 pairs in three geographic parts of its former range; and (3) protection and management of important migration and wintering habitat for feeding and roosting. Current estimates meet or exceed the first two criteria described in the recovery plan (Brad Bortner, personal communication, see "Notes"). Most historical nesting islands are protected and managed, in part, for Aleutian Canada goose recovery by the Alaska Maritime National Wildlife Refuge (USFWS 1991). Long-term protection and recovery efforts on important nesting islands has been greatly successful in expanding the Aleutian Canada goose's breeding range and population numbers. Population estimates of Aleutian geese wintering in California in winter 1995 reached 24,000 individuals (Brad Bortner, personal communication, see "Notes"), up from less than 800 geese in spring 1975. However, the lack of adequately protected migration and wintering habitat for Aleutian geese remains the greatest obstacle to full recovery (USFWS 1991).

The Aleutian Canada goose can be distinguished from most other subspecies of Canada geese by their small size (only cackling Canada geese are smaller), abrupt forehead with short bill, and a ring of white feathers at the base of the black neck in birds older than eight months. The Aleutian Canada goose is one of eleven subspecies of the familiar white-cheeked Canada geese.

Occurrence in the Project Area

The Aleutian Canada goose is an occasional visitor to the Suisun Marsh during spring and fall migration. Some individuals may stop for brief periods, before heading to wintering areas in the Central Valley or returning to the breeding grounds.

Project Impacts

There are no anticipated negative effects to the Aleutian Canada goose from the proposed SMPA Amendment Three actions, but it is included in species evaluation because it is federally listed as threatened.

The following SMPA Amendment Three actions are not anticipated to affect Aleutian Canada geese.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Managed Wetlands Improvement Fund.
- Drought Response Fund.
- Existing Facilities operation and maintenance.
- Establishing criteria for September SMSCG operations.
- Updating management plans.
- Water Manager Program.
- Joint-use Facilities Program.
- Portable Pumps Program.

These actions are anticipated to provide benefits to Aleutian Canada Geese populations. All proposed Amendment Three activities were established to improve management capabilities on the managed wetlands of Suisun Marsh. Today, the Suisun Marsh provides nearly 10% of California's remaining wetlands habitat as critical wintering area for the Pacific Flyway waterfowl populations.

Existing Environment and Cumulative Effects

The existing environment and ongoing activities which could negatively affect Aleutian Canada Geese and their habitat in the Suisun Marsh include but are not limited to the following.

- Reduction in breeding range due to predation from arctic fox.
- Habitat loss in wintering areas and spring and fall migration areas, resulting from land-use changes from agricultural practices to urban and industrial development.
- Subsistence and sport hunting which likely contributed to the original population decline.
- Increased urbanization and industrial development in areas outside the boundaries of the primary and secondary management areas of the Suisun Marsh Plan of Protection.
- Disturbance due to increased air traffic over the marsh from Travis Air Force Base.

Conclusion and Determination

Amendment Three actions were crafted to sustain and protect the managed wetland habitat within the Suisun Marsh. These wetlands are primarily managed to provide habitat to support waterfowl and resident and migratory wildlife. The Amendment Three actions are anticipated to provide benefits for the Aleutian Canada Geese in the Suisun Marsh.

Ferruginous Hawk, *Buteo regalis*

Status

Ferruginous hawks have declined substantially from historical numbers due largely to the widespread control of prairie dogs, a preferred food. The USFWS is awaiting further information about the species before deciding about listing them under the Endangered Species Act. The ferruginous hawk is currently considered a California species of special concern and a federal Migratory Nongame Bird of Management Concern.

Distribution

Ferruginous hawks range over the western half of North America. Those that breed in the northernmost portion of their range migrate south as far as central Mexico for the winter (Root 1988). In California, ferruginous hawks occur from about mid-September to early April (Small 1994). A few arrive in northern California as early as late August. During this time, their range is statewide. In northern California ferruginous hawks occur mostly in the northeastern valley, Sacramento, San Joaquin and Salinas valleys, and the interior valleys of the Coast Range south of Mendocino County (Small 1994). They may also occur along the coast where suitable habitat occurs. The first nesting ferruginous hawks observed in California were a pair in 1988 that bred on the Madeline Plains near Termo. Breeding there was recorded again in 1989 and may also have occurred in 1990 (Small 1994).

Habitat

The ferruginous hawk is a bird of open habitats capable of supporting large numbers of rodents and rabbits (Ehrlich and others 1988). Breeding occurs in open country, usually prairies, plains and badlands. In California, ferruginous hawks use most open habitat types with the exception of pure desert scrub. Preferred habitats include the interior lowlands, plateaus, valley and plains, grassland, ranches and agricultural fields, and desert edges (Small 1994).

General Ecology

The ferruginous hawk is the largest of the *Buteo* species. They also spending more time soaring than any other *Buteo* (Brown and Amadon 1968). Prey consists largely of rodents, including prairie dogs, ground squirrels, and mice, but also rabbits, snakes, and large insects (Root 1988). Ferruginous hawks may also hunt jackrabbits cooperatively.

Ferruginous hawks build perennial nests of sticks, bones, and rubbish, usually in a tree with a commanding view (Ehrlich and others 1988). Nests may become immense over time. While tall trees are preferred, nesting may also occur on rocky cliffs, slopes, and on the ground. Ferruginous hawks are monogamous and both parents participate in raising the young. Up to six eggs may be laid, but typically there are two to four. Incubation lasts between 28 and 33 days and the young fledge in approximately 44 to 48 days.

Occurrence in the Project Area

The ferruginous hawk is an occasional fall, winter, and spring visitor in Suisun Marsh. Breeding has probably never occurred there.

Project Impacts

Because the ferruginous hawk is only a rare visitor to Suisun Marsh and a non-breeder there, none of the proposed project actions are expected to negatively affect the species. Project actions that would decrease soil salin-

ity and allow increased vegetative growth may instead benefit ferruginous hawks by providing more suitable habitat for prey species.

The following Amendment Three actions are not expected to affect ferruginous hawks.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Existing Facilities operation and maintenance.
- Establishing criteria for September SMSCG operations.
- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repairs.
- Water Manager Program.
- Portable Pumps Program.
- Drought Response Fund.
- Managed Wetlands Improvement Fund.
- 75/25 Cost-share Program.
- 50/50 Cost-share Program.
- Updating management plans.
- Joint-use Facilities Program.

Amendment Three actions are not expected to affect ferruginous hawks.

Critical Habitat

There is no designated critical habitat for the ferruginous hawk in the project area.

Existing Environment and Cumulative Effects

It is unlikely there would be cumulative negative effects to ferruginous hawks resulting from the proposed project actions.

Conclusion and Determination

Amendment Three should not affect ferruginous hawks.

Western Snowy Plover, *Charadrius alexandrinus nivosus*

Status

Two geographically separate populations of western snowy plover are recognized, a Pacific coastal and an inland breeding population. The two are believed to be genetically isolated and have therefore been considered independently when evaluating the species for special protection. Pacific coastal snowy plovers, especially, have lost much of their former breeding range and the population continues to decline (Stenzel and others 1981). For these reasons, the coastal population was listed as threatened under the federal Endangered Species Act in 1993. The inland population is not listed federally but is considered a California State Species of Special Concern.

Causes of decline among the coastal population include habitat loss and degradation due to encroachment by humans and the exotic European beachgrass (*Ammophila arenaria*). Other causes include mortality due to recreation, vehicles, pets, and exotic predators (Stenzel and others 1981).

Distribution

The inland western snowy plover breeds in interior sites located in Oregon, California, Nevada, Utah, Colorado, Kansas, Oklahoma, New Mexico, north-central Texas, some coastal areas of southern Texas, and possibly extreme northeastern Mexico (USFWS 1993).

The coastal western snowy plover is defined as those individuals that nest near tidal waters, and includes all colonies on the mainland coast, peninsulas, bays, estuaries, and offshore islands (USFWS 1993). Officially, it is that portion of the population that breeds within 50 miles of the coast. The coastal western snowy plover ranges from Washington to southern Baja, Mexico with the largest portion of the population occurring in California. Because of its proximity to the Pacific coast, Suisun Marsh is located within the breeding range of the coastal western snowy plover.

Twenty breeding sites occur in California with eight of these supporting 78% of the California coastal population (Page and others 1991). San Francisco Bay is the northernmost breeding area in California and hosts the largest breeding population (Small 1994).

Habitat

Breeding habitats of the Pacific coastal population are mostly located along coastal beaches and include sand spits, open areas around estuaries, dune-backed beaches, unvegetated beach strands, and beaches along river mouths (Stenzel and others 1981; Wilson 1980, as cited in USFWS 1993). Other habitats used less commonly include salt pans, dry salt ponds, salt pond levees, and coastal dredged spoil disposal sites (Widrig 1980; Wilson 1980; Stenzel and others 1981, as cited in USFWS 1993b). Nest sites usually occur on flat, open, bare, or sparsely vegetated sandy or saline substrates.

In the San Francisco Bay, snowy plovers nest on salt pond levees and islands and the bottoms of dried salt ponds (Warriner and others 1986). Snowy plovers also nest on the outer coast along Ocean Beach. Foraging habitats in the San Francisco-San Pablo-Suisun Bay system are primarily salt ponds and secondarily tidal mud flats (Harvey and others 1992). In the Sacramento-San Joaquin Delta, foraging habitats consist primarily of oxidation ponds.

Snowy plovers, including the interior population, with the possible exception of some New Mexico birds, winter along the Pacific Coast

from Oregon to Mexico (Page and others 1991, as cited in USFWS 1993b). The majority of the wintering population occurs south of Bodega Bay, California.

Habitats occurring within Suisun Marsh that may be used by breeding snowy plover include sparsely vegetated or unvegetated open areas including the tops of levees, dry pond bottoms, and other sandy dry open areas. Foraging habitat would mostly consist of the margins of shallow ponds and sloughs, and possibly some sandy dry upland areas.

General Ecology

Snowy plover are the smallest of the North American plovers, measuring just 6.25 inches from bill to tail (Root 1988). Pacific coastal snowy plovers nest in loose colonies observed to number from 2 to 318 adults (USFWS 1993b). Most are philopatric, returning to the same breeding site in following years and often nesting in the exact location as the previous year (Warriner and others 1986). The coastal population breeds from about mid-March through mid-September. Eggs are laid between March and July (Warriner and others 1986). Two or three eggs are laid and both parents share with the incubation duties which last approximately 27 to 28 days. The young are precocial and leave the nest almost immediately after hatching. Broods usually leave the nesting area before fledging. Fledging occurs at about 31 days of age. Coastal snowy plovers will often double brood. Causes of reproductive failure largely include human disturbances and predation, but also inclement weather (USFWS 1993b).

The winter coastal population consists of both resident and migratory snowy plovers, as some coastal breeding birds migrate away from their breeding area and interior birds migrate to the coast (USFWS 1993b).

Snowy plovers forage along shorelines, within the intertidal zone, in dry beach areas above high tide, along salt marshes and salt ponds, and also on salt pans and spoil sites (USFWS 1993b). Their diet consists of small crustaceans and mollusks, fish, insects, and worms (Ehrlich and others 1988).

Occurrence in the Project Area

The frequency, number and distribution of snowy plover occurring in the Suisun Marsh is not well known because surveys have not been conducted there.

Project Impacts

The following actions included in Amendment Three are not expected to affect snowy plover.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Establishing criteria for September SMSCG Operations.
- Morrow Island and Lower Joice Island fish screens (provided no breeding snowy plover are present during installation).
- Roaring River Distribution System turnout repair (provided no breeding snowy plover are present during repairs).
- Portable Pumps Program.

The following actions included in Amendment Three could affect snowy plover.

Water Manager Program

Increases in water levels, such as shallow summer irrigation, could affect breeding snowy plover by destroying nests, eggs, and newly hatched young should they be present at the site.

Drought Response Fund

This action would provide funds for management activities such as discing, creation of V-ditches, and operation of portable pumps. Activities such as ditching and discing in or adjacent to a snowy plover breeding colony would likely cause reproductive failure. This action will fund efforts to write new management plans for private ownerships in the marsh. However, there should be no impacts to snowy plover provided they are not present during project activities.

Water Management Program

75/25 Cost-share Program. This program will replace or improve drainage facilities and allow for better control of hydroperiod and leaching cycles. Construction activities occurring in or adjacent to an active snowy plover breeding colony would likely cause reproductive failure. Breeding failure would also occur should snowy plover nests be inundated during pond flooding. However, there should be no impacts to snowy plover provided they are not present during project activities.

50/50 Cost-share Program. This program will facilitate the construction and maintenance of water deliver systems such as ditches in the managed wetlands, and could include the raising of pond bottom sinks and levee coring. Construction activities occurring in or adjacent to an active snowy plover breeding colony would likely cause reproductive failure. Snowy plover nesting on pond bottoms or levee crowns would be affected should the breeding area be disturbed during project activities. However, there should be no impacts to snowy plover provided they are not present during project activities.

Updating Management Plans

This action will fund efforts to write new management plans for private ownerships in the marsh. While updating the plans will not affect the species, the recommendations within the plans may result in increased activities like ditching, discing, and leach cycles. Construction activities occurring in or adjacent to an active snowy plover breeding colony would likely cause reproductive failure. Nest destruction and offspring mortality could also occur should nests be inundated during pond flooding. However, there should be no impacts to snowy plover provided they are not present during project activities.

Joint-use Facilities Program

This action incorporates many of the above-mentioned management activities and facilities construction into a plan for the joint-use of facilities by neighboring property owners. Activities include digging new ditches and cleaning of existing ones, improvement of water control structures and coring of common levees. Any of these activities would affect breeding snowy plover should they be present at the project site.

Because the San Francisco Bay area hosts California's largest breeding population of snowy plover and an even greater number of wintering birds, and because the project area itself contains apparently suitable snowy plover habitat, impacts to snowy plover are possible. Proposed project activities that involve disturbance of open substrates would affect breeding snowy plovers, if present in the project area, and most likely result in reproductive failure.

Critical Habitat

There is no designated critical habitat for western snowy plover in the project area.

Existing Environment and Cumulative Effects

Because the distribution of nesting and wintering snowy plover in Suisun Marsh is unknown, cumulative effects are difficult to estimate. Potential current on-going (human-caused) negative impacts to snowy plover and its habitat in Suisun Marsh include but are not limited to the following.

- Possible direct disturbance due to recreation, ongoing discing, mowing, pond filling, and levee work where snowy plover may be breeding.
- Possible flooding of nests.
- Possible temporary loss of shallow water foraging habitat to water level changes.

Conclusion and Determination

Some Amendment Three actions have the potential to affect snowy plover through direct disturbances to colonies resulting in reproductive failure, and possible temporary loss of foraging habitat. However, sensitive species surveys will be conducted in project areas are conducted prior to conducting activities with potential to affect nesting birds. If present, avoiding or delaying activities that could affect a breeding colony would substantially reduce negative or potential impacts to snowy plover.

American Peregrine Falcon, *Falco peregrinus anatum*

Status

The American peregrine falcon historically ranged across North America (Small 1994). However, by the 1960s eggshell thinning and other breeding impacts from organochlorine compounds, particularly DDT, nearly caused their extinction (Ehrlich and others 1988; Harvey and others 1992; Small 1994). By 1962 peregrine falcons east of the Mississippi River were extirpated. Whereas the species was considered fairly common in California in the 1940s with at least 100 breeding pairs (Grinnell and Miller 1944), by 1970 as few as two pairs remained (Small 1994).

Peregrine falcons were listed as endangered in 1970 under the federal Endangered Species Act and later under the California Endangered Species Act. A ban on the use of DDT, combined with successful captive breeding and release programs, have resulted in the apparent recovery of peregrine falcons in California and over much of the rest of the species former North American range. The species was removed from State and federal threatened and endangered species lists this year but remains a California State Species of Special Concern.

Distribution

Worldwide, peregrine falcons have the greatest range of any bird (Ehrlich and others 1988). The present California population numbers approximately 200 individuals with about 80 known breeding pairs (Small 1994). Breeding mostly occurs along the inland north coastal range, along the coast from Del Norte County south to, and including, the Channel Islands, in the Klamath Mountains south along the west side of the Sacramento Valley to Colusa and Lake counties, and from the Cascade range south along the west side of the Sierras to Fresno County (Small 1994; Harvey and others 1992).

Recently, however, four pairs of peregrine falcons have begun nesting in the San Francisco Estuary at two sites in the Central Bay and one site in Suisun Bay (Harvey and others 1992). Pair activity without documented breeding attempts have been observed in the South Bay and western Delta. Two more pairs have also apparently become established at coastal sites in Marin and San Mateo counties.

The winter population of peregrine falcons in California increases when birds from the north migrate southward. The peregrine falcon's range in California is statewide especially near coastal areas (Small 1994). They are, however, only rare winter visitors east of the Sierra crest and in the eastern and southeastern desert regions. The San Francisco Bay and Delta region is considered an important wintering area where as many as 20 peregrine falcons inhabit the area (Harvey and others 1992).

Habitat

Traditional nesting habitat consists of cliff ledges and rocky promontories mainly in coastal, woodland and forest habitats and within hunting range of prey (Ehrlich 1988; Harvey and others 1992; Small 1994). Any wetland habitat, with the exception of riparian areas, provides potential foraging habitat for both breeding and wintering peregrine falcons. Many reintroduced peregrine falcons also now nest on towers, tall building ledges and bridges where they include more pigeons and passerines in their diet.

General Ecology

Peregrine falcons are the fastest fliers in nature having been clocked at speeds of up to 220 miles per hour. Prey consists mostly of ducks, shorebirds, pheasants and pigeons often taken in flight and hunted cooperatively by pairs (Ehrlich and others 1988). Peregrine falcons are monogamous and produce a single brood a year. Clutch size averages between three and four eggs but may range from two to six. Incubation lasts 29 to 32 days with fledging occurring at about 35 to 42 days of age. The male does the hunting at first while the female broods and feeds the chicks. Cliff nest sites may be used traditionally for many years (Ehrlich 1988).

In the Bay Area, peregrine falcons prey opportunistically on shorebirds, pigeons, terns and several passerine species (Harvey and others 1992). Telemetry studies in the Bay Area have also shown substantial use of transmission line towers as perching sites.

Occurrence in the Project Area

At least one pair of peregrine falcons nests in the Suisun Bay area and as many as 20 birds winter in and nearby the project area (Harvey 1988).

Project Impacts

The following actions included in Amendment Three are not expected to affect peregrine falcons.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Establishing criteria for September SMSCG Operations.
- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repair.
- Water Manager Program.
- Portable Pumps Program.
- Drought Response Fund.
- Managed Wetlands Improvement Fund.
- Update Management Plans.
- Joint-use Facilities Program.

Because peregrine falcons nest well above ground level, none of the proposed project actions for Suisun Marsh should substantially disrupt breeding efforts. Instead, breeding and wintering peregrine falcons in and nearby Suisun Marsh are expected to benefit from project actions designed to increase waterfowl abundance, as this will enhance the available prey base.

Critical Habitat

There is no designated critical habitat for the peregrine falcon in the project area.

Existing Environment and Cumulative Effects

It is unlikely there would be cumulative negative impacts to peregrine falcons resulting from the proposed project actions.

Conclusion and Determination

Amendment Three actions may benefit peregrine falcons.

Salt Marsh Common Yellowthroat, *Geothylpis trichas sinuosa*

Status

The salt marsh common yellowthroat (*Geothlypis trichas sinuosa*) is a Category 2 candidate species for protection under federal law. The species is not listed under the California Endangered Species Act.

Distribution

The salt marsh common yellowthroat is found all year in the San Francisco Bay region. The subspecies is believed to winter in coastal marshes as far south as San Diego County. It breeds in fresh and brackish marshes around the inland margins of San Francisco Bay, east to Carquinez Straits, and in coastal marshes from Tomales Bay to Pescadero Marsh (Foster 1977). Salt marsh yellowthroats migrate from fresh and brackish marsh breeding sites to bayward salt marshes in the fall when seasonal emergent marsh vegetation dies back (Foster 1977).

Hobson and others (1985) recorded a total of 569 breeding pairs of salt marsh common yellowthroats at 23 locations throughout the estuary. Breeding pairs were detected in Alameda, Santa Clara, San Mateo, San Francisco, Marin, Sonoma, and Napa counties. Birds were caught with mist nets and banded at Joice Island in Suisun Marsh, the Suisun Bay shoreline near Benicia, and the Benicia State Recreation Area to determine the subspecific identity of yellowthroats in Suisun Marsh and the Carquinez Straits (Hobson and others 1985). The results of these surveys were inconclusive. To date, the breeding range of the salt marsh common yellowthroat subspecies is undefined (Marshall and Dedrick 1993).

Habitat

Salt marsh common yellowthroats use dense vegetative growth associated with wetland conditions and high densities of insects. When breeding, salt marsh common yellowthroats prefer plant communities that include brackish marsh, freshwater marsh, and woody swamp areas with dense, tangled vegetation for continual concealment. The birds are most often observed in coyote bush (*Baceharis pilularis*) or emergent tule (*Scirpus* spp.) and cattail (*Typha* spp.) stands close to the water.

Birds arrive in their breeding territories in mid-March. Nest building activities begin in middle to late April. Nest form is variable depending on vegetation composition of the breeding habitat and nests are often built in tall tules over the water. Both adults care for the nestlings and fledglings and a second brood is often produced. Courtship and territories are re-established for the second brood and second clutches are usually fledged by mid-July.

General Ecology

The common yellowthroat (*Geothylpis trichas*) is a small, marsh-dwelling warbler. There are twelve subspecies of this parulid warbler with three subspecies known to the western states (AOU 1957). The salt marsh subspecies (*G. t. sinuosa*) was first described as being smaller, dorsally and laterally darker, and with shorter wing length than the other subspecies (Grinnell 1901). The plumage differences between subspecies can only be distinguished during post-breeding season molt which occurs between July and September.

Occurrence in the Project Area

Salt marsh common yellowthroats were caught with mist nets and banded at Joice Island in Suisun Marsh, the Suisun Bay shoreline near Benicia, and the Benicia State Recreation Area to determine the subspecific identity of yellowthroats in Suisun Marsh and the Carquinez Straits (Hobson and others 1985). The results of these surveys were inconclusive. Yellowthroats are commonly seen in tall emergent vegetation within diked managed and tidal wetlands of the Suisun Marsh, but it is unknown if these populations are salt marsh common yellowthroats. To date, the breeding range of the salt marsh common yellowthroat subspecies is undefined (Marshall and Dedrick 1993). It breeds in fresh and brackish marshes around the inland margins of San Francisco Bay east to Carquinez Straits, and in coastal marshes from Tomales Bay to Pescadero Marsh (Foster 1977). Salt marsh yellowthroats migrate from fresh to brackish marsh breeding sites to bayward salt marshes in the fall when seasonal emergent marsh vegetation dies back (Foster 1977).

Project Impacts

The following Amendment Three actions are not expected to affect salt marsh common yellowthroats.

- Making salinity standards consistent with the 1995 and 1998 Water Quality Control Plans.
- Converting S-35 and S-97 to monitoring stations.
- Establishing criteria for September SMSCG operations.
- Lower Joice Island and Morrow Island fish screens.
- Roaring River Distribution System turnout repairs.
- Updating management plans.
- Drought Response Fund.
- Portable Pumps Program.
- Water Manager Program.

Managed Wetlands Improvement Fund

There are no anticipated negative effects to salt marsh common yellowthroats from the continued implementation of the 75/25 Cost-share Program. There are no anticipated negative effects to salt marsh common yellowthroats from the 50/50 Cost-share Program, except for the ditch-cleaning activities. There is a possibility that some minor, short-term effects to salt marsh common yellowthroats could occur from the removal of emergent vegetation during ditch-cleaning activities. Periodic cleaning of existing water conveyance ditches is required to ensure proper drainage and water circulation. Over time, siltation of some ditch systems occurs and emergent vegetation encroaches into the water conveyance channel. This vegetation may provide habitat in the managed wetlands for salt marsh common yellowthroats and removal of the vegetation could displace individuals. When ditches are cleaned, emergent vegetation is removed from the center of the ditch with vegetation left on the edges of the ditch. Effects from vegetation removal is anticipated to be minimal because typically the ditches are cleaned in late summer when water levels in the ditches are low or dry. The salt marsh common yellowthroat may not be present during this time because the species migrates from fresh and brackish marsh breeding sites to bayward salt marshes in the fall when seasonal emergent marsh vegetation dies back (Foster 1977).

Existing Facilities Operation and Maintenance

Existing Facilities operation and maintenance, the Lower Joice Island fish screen, and the Cygnus Unit are not anticipated to affect salt marsh common yellowthroats. The operation of the Morrow Island Distribution System, the Roaring River Distribution System, and the Goodyear Slough Outfall should not affect salt marsh common yellowthroats, but the maintenance of these channels through the removal of emergent vegetation may displace some individuals. These facilities were originally designed as water conveyance structures and, over time, siltation of the ditches and encroachment of vegetation typically occurs. When these channels are cleaned to restore them to original capacity, emergent vegetation is typically removed from the center of the channel with vegetation remaining on the edges. This ditch-cleaning maintenance activity usually occurs in late summer and early fall, after water deliveries to the managed wetlands are complete and the water level in the ditches is low or dry. The salt marsh common yellowthroat should not be affected by this activity, because they migrate from fresh and brackish marsh breeding sites to bayward salt marshes in the fall when seasonal emergent marsh vegetation dies back (Foster 1977). SMSCG operations are not known to adversely affect salt marsh common yellowthroats in the Suisun Marsh. The incremental changes in channel water salinity due to SMSCG operation are not expected to reduce or affect brackish marsh vegetation that the salt marsh common yellowthroat uses for foraging and breeding habitat.

Joint-use Facilities Program

There are no anticipated negative effects to salt marsh common yellowthroats from the implementation of the Joint-use Facilities Program activities, except for the cleaning of existing water conveyance ditches as described previously.

Critical Habitat

There is no designated critical habitat for the salt marsh common yellowthroat in the project area.

Existing Environment and Cumulative Effects

The current and ongoing environmental considerations which may be affecting the salt marsh common yellowthroats are listed below.

- Losses of salt marsh wintering habitat habitats due to wetland fill, diking, and channelization of bay and coastal wetlands.
- Decreases in California's fresh and brackish water wetlands for breeding habitat.
- Predation from raptors and owls.
- Accidents, such as oil spills, or chemical contamination of tidal wetlands.
- Mosquito control and use of pesticides that affect forage items.

Conclusion and Determination

All work activities proposed in Amendment Three will occur within the diked managed habitats of the Suisun Marsh. Therefore, none of the proposed activities are anticipated to affect the salt marsh common yellowthroat, except for the removal of emergent vegetation by ditch cleaning. This activity may have some minimal effects to the salt marsh common yellowthroat, but is not anticipated to be significant.

Bald Eagle, *Haliaeetus leucocephalus*

Status

The bald eagle was listed as endangered under the federal Endangered Species Act in 1967. It was downgraded to threatened status throughout the lower 48 states in 1995 and the USFWS is currently preparing a proposal to de-list this species. The bald eagle was removed from the State and federal threatened and endangered species lists this year. The bald eagle is presently considered a California State Species of Special Concern.

Distribution

Bald eagles are a North American species, occurring from Alaska to northern Mexico. Approximately 70 pairs of bald eagles presently breed in California (Small 1994). Prior to population decline in the middle part of the century, bald eagles nested throughout California, including southern California and the Channel Islands. Breeding today occurs mostly in scattered areas in the Sierra foothills and in north-central California and northeastern California. At present the California wintering population numbers between approximately 900 and 1,000 individuals (Small 1994). Highest winter densities in California are found around lakes in the Klamath Basin where approximately 450 individuals occur. The remainder are scattered across the state, but are mostly found west of the Sierra crest in the northern half of the State.

Habitat

Both breeding and wintering habitat consists of quiet open areas along rivers, lakes, reservoirs, and portions of the coast.

Habitats occurring within Suisun Marsh that may be used by bald eagles are mostly open water areas, including ponds and sloughs where the birds may hunt fish and waterfowl.

General Ecology

Bald eagles mate for life (Ehrlich and others 1988). During the breeding and non-breeding seasons, they are usually found in pairs. Hunting may be cooperative with one bird assuming the chase should the first tire. Food consists mostly of fish, particularly dead and dying salmon (Brown and Amadon 1968), but also waterfowl, mammals and carrion (Root 1988). Though frequent scavengers, bald eagles are also capable of catching prey, as large as a goose, on the wing. Waterfowl and mammals become the primary prey items when there is extensive ice or when water levels become high (Lingle and Krapu 1986 in Root 1988). Food piracy from other birds, including ospreys and crows is common among immature bald eagles (Brown and Amadon 1968). Piracy from other bald eagles is usually unsuccessful. Bald eagles will use the presence of other bald eagles as a cue to food sources.

Bald eagles build stick nests in tall trees or rocky cliff ledges. Nests may be reused from year to year and can become very large in time, measuring ten feet or more in diameter and weighing as much as 2,000 pounds. Only one brood per year is produced. Clutch size averages approximately two eggs (range equals one to three). Eggs hatch asynchronously after approximately 34 to 36 days of incubation. The second chick typically starves due to competition with its larger sibling. Fledging occurs between 70 and 98 days of age with the young become independent at approximately four months.

Occurrence in the Project Area

The bald eagle is a rare localized winter resident in the northern and eastern periphery of the San Francisco Estuary (Harvey and others 1992) and only a casual visitor in Suisun Marsh. Bald eagles are attracted to salmon runs and congregations of waterfowl, and therefore may use Suisun Marsh for foraging.

Project Impacts

The following actions included in Amendment Three are not expected to affect bald eagles.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Establishing criteria for September SMSCG Operations.
- Morrow Island and Lower Joice Island Fish Screens.
- Roaring River Distribution System turnout repair.
- Water Manager Program.
- Portable Pumps Program.
- Drought Response Fund.
- Managed Wetlands Improvement Fund.
- Updating management plans.
- Joint-use Facilities Program.

Because the bald eagle is only a rare visitor to Suisun Marsh and a non-breeder there, none of the proposed project actions are expected to negatively affect the species. Project actions designed to increase waterfowl use of the Marsh may instead benefit bald eagles by increasing the available prey base.

Critical Habitat

There is no designated critical habitat for the bald eagle in the project area.

Existing Environment and Cumulative Effects

There are not likely to be cumulative negative impacts to bald eagles resulting from the proposed project actions. Cumulative positive impacts may occur, however, as more waterfowl use the marsh during winter months when bald eagles are present.

Conclusion and Determination

Amendment Three actions could benefit bald eagles.

Suisun Song Sparrow, *Melospiza melodia maxillaris*

Status

In 1987, the USFWS received a petition to list the Suisun song sparrow as endangered. That request was deemed unwarranted and threatened status was considered more appropriate. The Suisun song sparrow is currently a federal species of concern. The Suisun song sparrow was recently considered by the California Fish and Game Commission for possible State listing as threatened, but no action was taken (Larsen 1989).

Distribution

The Suisun song sparrow is a distinct subspecies completely endemic to Suisun Bay. Previous literature suggested that these birds are confined to undiked tidal marshes. However, field surveys by DFG and DWR have observed Suisun song sparrows along distribution ditches, permanent ponds, and other areas in diked wetlands of Suisun Marsh where required plant assemblages and brackish water conditions exist (Brenda Grewell, personal communication, see "Notes") In a study by Marshall (1948a), approximately 6,000 pairs remained in 13 isolated fragments. The largest population fragment was 1,300 pairs; the smallest was 20 pairs. The Suisun song sparrows were divided into three separate populations by geographic barriers: North Suisun, South Suisun, and Southampton Bay. The densest population was seen in those sections of Southampton Bay containing the richest variety of brackish plant species (Marshall 1948a). On a year-round basis, Suisun song sparrows are very sedentary, never making long flights over unfamiliar habitat. This behavior coupled with the severe fragmentation of brackish tidal marsh habitat predisposes the Suisun song sparrow to the threat of local extinction. Once a small isolated population is extirpated, re-establishment from other fragments will be very limited, if occurring at all (Larsen 1989).

Habitat

Intermixed stands of bulrush (*Scirpus* spp.), cattail (*Typha* spp.), and other emergent vegetation provide suitable habitat. Suisun song sparrows use the tallest, centermost *Scirpus acutus* patch for song and calling perches and find concealment in the piles of dead stems below. Territories for each pair of song sparrows is usually limited to a patch of *Scirpus acutus* standing above the surrounding vegetation. For perching, these birds usually avoid *Scirpus robustus* where it grows in low packed stems. Suisun song sparrows forage on the bare surface of tidally exposed mud among the tules and along slough margins in the brackish marshes of Suisun Bay during low tides. They feed mostly on *Scirpus* (bulrush) seeds from the ground, once they fall from flower heads above. They also feed on the insects (mostly mosquito larvae and flies) and other invertebrates exposed during low tides (Marshall 1948a). In feeding, the Suisun song sparrow hops with both feet together, picks up seeds or small invertebrates from the ground with its bill, then husks or cracks them open between the edges of the mandible and maxilla. It scratches leaf litter by pushing both feet simultaneously and repeatedly backward to produce a rocking motion over the same spot. Small food items are swallowed whole to be ground up by small stones in the gizzard. These rocks are collected each day and voided at night. At dusk, the gizzard is filled with rocks and the esophagus is distended with seeds up to the mouth.

Suisun song sparrows occupy small territories during the breeding season. Nests are strung

along edges of sloughs and bays in linear fashion, at 48 to 70 yard intervals. As the fringe width of *Scirpus* and *Typha* widens, distances between adjacent nests increase. Open marsh more than ten yards from the winding tidal channels are avoided. Each territory must have enough area for nesting and foraging, including tidally exposed mud, water, and vegetation suitable for nesting cover while foraging (Walton 1975). The vegetation must also harbor food and include permanent water or moisture in the form of tidal ebb and flow (Marshall 1948a). Nests are placed at a height in the vegetation where they can clear flood tide levels while still having cover from taller plants. If the tallest available plants are used the nests could possibly be overexposed to predation. Nests are never used more than once (Johnston 1956a). Territorial density runs from eight to ten pairs per acre. While foraging, Suisun song sparrows are not limited to their territorial areas. Adults are faithful to their territory in successive years, except when a displacement causes a whole row of occupants to shift next door, like a game of musical chairs (Josh Collins, personal communication, see "Notes"). They are the only obligate ground foraging bird in the tidal brackish marsh and occupy an uncontested niche by foraging on the surface of the mud (Larsen 1989). Diking, channelization, development, and a substantial decrease in freshwater outflow from the Sacramento-San Joaquin Delta have greatly reduced the habitat that supports this subspecies. The remaining habitat is highly fragmented, existing in thin strips along the inside edges of tidal sloughs.

Suisun song sparrows are the sole non-probing ground foraging birds of their habitat. Other birds such as marsh wrens, yellowthroats, and red-winged blackbirds exist in these habitats, but they forage in the upper parts of the foliage rather than on the ground. Besides competition from small mammals such as shrews (*Sorex sinuosus*) and mice (*Reithrodontomys raviventris halicoeres* and *Microtus californicus*), the Suisun song sparrow enjoys little competition for foraging area in its habitat. Black shouldered kites (*Elanus caerulezis*), northern harriers (*Circus cyaneus*), and short-eared owls (*Asio flammeus*) are the predatory raptors in this habitat. Predation reduces numbers of juveniles by 80% to 85% by the following spring (Johnston 1956b).

General Ecology

The Suisun song sparrow is a small passerine of chunky build and rounded outline, with large feet, conical bill, rounded wingtips, slender tail, and streaked whitish underparts. Coloration between the black feather shafts and back is the best feature distinguishing the Suisun song sparrow from phenotypically similar subspecies endemic to marshes bordering the San Francisco and San Pablo bays. *Mm. samitefis* (from San Pablo Bay) is blackish olive-brown, *Mnr. pusillula* (San Francisco Bay) is either yellowish gray or plain gray, while *Mm. maxitlaris* is dark reddish brown. The Suisun song sparrow is also unique in its larger bill depth (7.5 to 7.6 mm), and convexly flared inasiflac. Wing lengths average 60 mm, weight is variable with age and sex. The larger, more powerful bill of maxillaris was evolved for cracking the larger seeds of its environment. Like all other subspecies, the Suisun Song sparrow has a long, rounded tail, which is purriped during flight. Eyebrows are grayish and a broad, dark stripe borders a whitish throat. Streaking occurs on upper pans and sides of the breast. Legs and feet are a pinkish color, Besides a unique timbre and division into three phases, these birds have an almost infinitely variable song repertoire.

Occurrence in the Project Area

The Suisun song sparrow is a distinct subspecies completely endemic to Suisun Bay. Previous literature suggests that these birds are

confined to undiked tidal marshes. However, DFG and DWR biologists have conducted field surveys and observed Suisun song sparrows along distribution ditches, permanent ponds, and other areas within diked wetlands of Suisun Marsh (Brenda Grewell, personal communication, see "Notes").

Project Impacts

The following Amendment Three actions are not expected to affect Suisun song sparrows.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Establishing criteria for September SMSCG operations.
- Updating management plans.
- Drought Response Fund.
- Portable Pumps Program.
- Water Manager Program.
- Roaring River Distribution System turnout repairs.
- Lower Joice Island fish screen.

Managed Wetlands Improvement Fund

Except for the ditch-cleaning activities, 50/50 Cost-share Program activities are not expected to affect Suisun song sparrow. Although most literature states that Suisun song sparrows typically use tidal wetlands not managed habitats, the removal of emergent vegetation during ditch-cleaning activities could potentially result in some minor, short-term effects to Suisun song sparrow if Suisun song sparrows are using managed wetland habitats. Periodic cleaning of existing water conveyance ditches is required to ensure proper drainage and water circulation. Over time, siltation of ditch systems occurs and emergent vegetation encroaches into the water conveyance channel. This vegetation may provide newly established habitat in the managed wetlands for Suisun song sparrows, but when vegetation is removed, it could displace some individuals. Any potential effects are anticipated to be minimal because these activities only occur during the late summer in managed wetland habitats. There are no anticipated negative effects to Suisun song sparrows from the continued implementation of the 75/25 Cost-share Program.

Existing Facilities Operation and Maintenance

SMSCG operations, the Lower Joice Island fish screen, and the Cygnus Unit are not expected to affect Suisun song sparrow. The operation of the Morrow Island Distribution System, the Roaring River Distribution System, and the Goodyear Slough Outfall is also not expected to affect Suisun song sparrow, but the long-term maintenance of these channels through the removal of emergent vegetation may displace some individuals as described previously under the Managed Wetlands Improvement Fund section.

Joint-use Facilities Program

There are no anticipated negative effects to Suisun song sparrows from the implementation of the Joint-use Facilities Program, except for the cleaning of existing water conveyance ditches as described previously under the Managed Wetlands Improvement Fund section.

Critical Habitat

There is no designated critical habitat for the Suisun song sparrow in the project area.

Existing Environment and Cumulative Effects

Listed below are the current and ongoing environmental considerations which may be affecting the Suisun song sparrow.

- Population fragmentation due to geographic barriers.
- Habitat fragmentation from wetland fill, diking, channelization of tidal habitats.
- Decreases in freshwater outflow from the delta has reduced habitat which supports this subspecies.
- Predation from raptors and owls.
- Accidents, such as oil spills, or chemical contamination of tidal wetlands.

Conclusion and Determination

All work activities proposed in Amendment Three will occur within the diked managed habitats of the Suisun Marsh and most literature states that Suisun song sparrows typically use tidal wetlands not managed habitats. Therefore, the proposed activities are not expected to affect the Suisun song sparrow, unless the birds are using managed wetland habitats. If Suisun song sparrows are using managed wetlands, the removal of emergent vegetation during ditch-cleaning activities may have some minimal effects to potential habitat. However, this effect is not anticipated to be significant.

White-faced Ibis, Plegadis chihi

Status

The white-faced ibis (*Plegadis chihi*) is currently a California State Species of Special Concern. The federal government is awaiting further information before determining whether they should be listed as threatened or endangered under the Endangered Species Act.

Distribution

White-faced ibis mostly breed in the western United States, Mexico and southern South America but also in Florida and Louisiana (Ryder 1967). Their range has been reduced this century because of habitat loss, direct human activities, and heavy pesticide use (for example, in Texas). The population and breeding range of white-faced ibis, in California especially, have undergone substantial reduction due mostly to wetland habitat loss and human disturbance (Ryder 1967; Small 1975). There is however, indication that white-faced ibis may be re-occurring in portions of California where irrigated agricultural fields have replaced former habitat. Small numbers of white-faced ibis breed in the Sacramento-San Joaquin Delta and Sacramento and northern San Joaquin valleys (USGS Breeding Bird Survey). Small numbers also winter in portions of southern and northern California including the Sacramento-San Joaquin Delta area (National Audubon Society Christmas Bird Count).

Habitat

White-faced ibis typically breed in mixed colonies of conspecifics, herons and egrets, but may also share colony sites with ducks and gulls (Palmer 1962). Nest densities can be relatively high, averaging as little as one meter from the nearest neighbor. Nesting primarily occurs in dense bulrush (*Scirpus* spp.) and cattail (*Typha* spp.) marshes where nests are floated over water. Breeding may also occur in dry land habitats where nests are typically placed on the ground (Burger and Miller 1977). Reproductive success in dry land colonies may, however, approach zero in some colonies due to nestling predation. Foraging habitat in both the breeding and nonbreeding seasons occurs in marshes and irrigated fields, including rice fields, where the birds probe the soil for aquatic invertebrates and earthworms. Winter roosts are often also in dense deep water marshes (Ehrlich and others 1988).

Habitat occurring within Suisun Marsh that may be used by white-faced ibis mostly includes dense cattail and bulrush marshes, shallow flooded areas and moist grassy and herbaceous uplands.

General Ecology

White-faced ibis may use the same nesting sites repeatedly for years, especially in marshes (Ehrlich and others 1988). Other sites may only be used intermittently. In dry years breeding may be postponed until the following year. Novel breeding sites will also be used should conditions become favorable. For example, approximately 700 white-faced ibis nested in a sugar plant's wastewater pond in Yolo County in 1990 adjacent to extensive rice fields that the birds used for foraging.

Post breeding dispersal is common at many colonies, probably due to substantial reduction of the food base during the nesting season (Ryder 1967). White-faced ibis wander in fall and winter throughout the west, sometimes through several states, stopping in marshes and irrigated areas to forage. Mortality is not well documented in the literature, but was esti-

mated at greater than 50% for first year birds. Death was due largely to shooting. Mortality for second year and older birds was greater than 40%. Age at first breeding may not be until two or three years (Ryder 1967).

Occurrence in the Project Area

The frequency, number and distribution of white-faced ibis occurring in the Suisun Marsh is not well known because surveys have not been conducted there. Both nesting and foraging habitat is available to breeding white-faced ibis, as is appropriate winter foraging and roosting habitat in and around the project area.

Project Impacts

The following actions included in Amendment Three are not expected to affect white-faced ibis.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Establishing criteria for September SMSCG Operations.
- Morrow Island and Lower Joice Island fish screens (provided breeding colonies are not located at the sites during installation).
- Roaring River Distribution System turnout repair (provided breeding colonies are not located at the site during repairs).
- Water Manager Program.
- Portable Pumps Program.

The following actions included in Amendment Three could affect white-faced ibis.

Drought Response Fund

This action would provide funds for management activities such as discing, creation of V-ditches, and operation of portable pumps. Activities such as ditching and discing in or adjacent to a breeding white-faced ibis colony could nest failure and possibly abandonment.

Managed Wetlands Improvement Fund

75/25 Cost-share Program. This program will replace or improve drainage facilities and allow for better control of hydroperiod and leaching cycles. Construction activities occurring in or adjacent to active breeding colonies could cause nesting failure and possibly colony abandonment. Water level changes could affect white-faced ibis by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of marsh vegetation. However, there should be little or no effect to white-faced ibis provided they are not present during project activities.

50/50 Cost-share Program. This program will facilitate the construction of water deliver systems such as ditches in the managed wetlands. Construction activities occurring in or adjacent to active breeding colonies could cause nesting failure and possibly colony abandonment. Water level changes could affect white-faced ibis by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of marsh vegetation. However, there should be little or no effect to white-faced ibis provided they are not present during project activities.

Updating Management Plans

This action will fund efforts to write new management plans for private ownerships in the

marsh. While this action in itself will not cause impacts, activities recommended in the plans may result in increased activities like ditching, discing, and leach cycles. Because white-faced ibis consume brackish as well as fresh water invertebrates, decreases in soil water salinity should not affect them. Water level changes could affect white-faced ibis by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of marsh vegetation. However, there should be little or no effect to white-faced ibis provided they are not present during project activities.

Joint-use Facilities Program

This action incorporates many of the above-mentioned management activities and facilities construction into a plan for the joint-use of facilities by neighboring property owners. Activities occurring in or adjacent to nesting white-faced ibis could cause nest failure and colony abandonment. Water level changes could affect white-faced ibis by inundating nests, or, conversely, by increasing predation by land-based mammals following dewatering of marsh vegetation. However, there should be little or no effect to white-faced ibis provided they are not present during project activities. Water level changes could also affect availability of foraging habitat.

Because they are a colonial species, white-faced ibis are particularly prone to impacts. Disturbances in or near a breeding colony, would likely cause substantial reproductive failure. Because white-faced ibis also forage colonially, substantial loss of foraging habitat during the breeding and nonbreeding seasons could affect foraging efficiency within the project area.

Critical Habitat

There is no designated critical habitat for the white-faced ibis in the project area.

Existing Environment and Cumulative Effects

Because the distribution of nesting and wintering white-faced ibis in Suisun Marsh is not well known, cumulative effects are difficult to estimate. Current on-going potential (human-caused) negative impacts to white-faced ibis and their habitat in Suisun Marsh include but are not limited to the following.

- Possible direct human disturbance, including removal of vegetative nest substrate and water level changes in breeding colonies.

- Temporary loss of shallow water foraging habitat to drainage or water level increases.

Conclusion and Determination

Some Amendment Three actions have potential to affect white-faced ibis directly by causing nesting failure and colony abandonment, and through loss of foraging habitat and possible nest failure resulting from water level changes. Knowledge of the species' distribution during the breeding and non-breeding seasons would enable better assessment of potential impacts and their cumulative affects. However, project areas would be surveyed, as described in Amendment Three, for sensitive species including breeding white-faced ibis prior to conducting activities with potential to affect nesting birds,. If present, avoiding or delaying activities that could affect a breeding colony would substantially reduce or eliminate potential negative impacts to white-faced ibis.

California Clapper Rail, *Rallus longirostris obsoletus*

Status

The California clapper rail (*Rallus longirostris obsoletus*) is listed as an endangered species under both the State and federal endangered species acts. The federal recovery plan for California clapper rails is currently being revised as a tidal marsh ecosystem recovery plan.

Distribution

The historical range of California clapper rails extended from Humboldt Bay to Morro Bay, and were historically abundant in tidal marshes of the San Francisco Estuary (Grinnell 1915; Grinnell and Miller 1944). Between 1850 and 1913, sport and market hunting depleted California clapper rail populations. Populations showed some recovery after hunting this species was prohibited in 1913 (USFWS 1984). The geographic range of this species is now restricted to the San Francisco Estuary. The total California clapper rail population in the 1970s was estimated at 4,200 to 6,000 individuals (Gill 1979). During the 1980s, the species declined dramatically to about 1,500 individuals in 1987 (Harvey 1988). The population was estimated to be 700 in 1988 and, as of 1990, between 300 and 500 individuals remained (Foerster and others 1990). California clapper rails have been documented from Suisun Marsh downstream through the North and South bays of the San Francisco Estuary.

Habitat

California clapper rails use a variety of habitat types within the San Francisco Estuary (DWR 1994; Garcia 1995). Occupied habitats range from large undiked salt marshes dominated by pickleweed (*Salicornia virginica*) with California cordgrass (*Spartina foliosa*) at low intertidal channel edge to brackish marsh with a saltgrass-pickleweed association in the high intertidal zone grading to tall emergent bulrushes (*Scirpus* spp.) and cattails (*Typha* spp.) in the lower intertidal zone (DWR 1994; Garcia 1995; Evens and Collins 1992). California clapper rails are known to nest in pickleweed, California cordgrass, and gumplant (*Grindelia stricta*) in Central Bay and South Bay marshes, while rails in the north bay have shown a nesting preference for alkali bulrush (*Scirpus maritimus*), pickleweed, and gumplant (Garcia 1995; Collins and others 1994; Evens and Collins 1992). California clapper rails nest near tidal sloughs and creeks in dense cover near the channel. If tidal floods disrupt nesting, the birds may renest in pickleweed at high marsh elevations. Diked managed wetlands do not support breeding habitat for California clapper rails, but they are known to use diked wetlands as refugia from high winter flood tides.

General Ecology

California clapper rails feed in intertidal mudflats and within high intertidal marsh vegetation at low tide. California clapper rails feed by probing in mud or by picking up food found on the surface of the ground or in vegetation. Their diet consists of parasitic worms, clam worms, snails, clams, crabs, insects, spiders, fish, and sometimes plant material (Williams 1929; Moffitt 1941).

Occurrence in the Project Area

From the time of the seminal work of Grinnell and Miller (1944) through the early 1970s, it was assumed that California clapper rails were restricted to the reaches of the San Francisco Estuary downstream of Carquinez Straits. However, comprehensive surveys of potential California clapper rail habitat in Suisun Marsh

were not conducted for the first time until 1979 (Harvey 1980). DeGroot (1927) reported that California clapper rail numbers were fairly common in the northern half of the bay region, but declined around the turn of the century when tidal marsh was drained for agricultural and industrial development. The more recent precipitous decline is believed to be the result of further loss and degradation of tidal marsh habitat and excessive predation by red fox.

Habitat for California clapper rails has been present in Suisun Marsh before extensive diking of Suisun wetlands began in the 1870s. There is historical evidence of halophytic plant communities in Suisun prior to State and federal water project development and early upstream diversions for agriculture on the Sacramento River (Wells 1995; Wells and Goman 1995). George and others (1965) and Mason (1972) reported that vegetation on Grizzly Island prior to diking was a saltgrass-pickleweed association, and an early history of Solano County refers to the pickleweed saltmarshes at Montezuma Slough near the present site of the SMSCG (Wood, Alley and Co. 1879). Current vegetation communities in undiked Suisun tidal marshes and the historical occurrence of rare halophytes which are restricted to Suisun, such as Suisun thistle and soft bird's beak, further suggest that California clapper rail habitat has historically been present in this reach of the estuary. It is likely that the inaccessibility of these private lands to early ornithologists precluded early detection of rails.

Anecdotal accounts of California clapper rails date back to the 1940s, when hunting clubs apparently heard, observed, and hunted this species (Arnold 1996; Tony Arnold, personal communication, see "Notes"). A guide to the flora and fauna of Solano County indicates California clapper rails were present in Suisun Marsh along Suisun Slough (Neitzel 1965).

Mall and Rollins (1972) report:

> Aside from the importance of waterfowl of the Pacific Flyway, the Suisun Marsh provides critical habitat for a host of other wildlife forms. Such endangered, rare, or unique species as the peregrine falcon, white tailed kite, bald eagle, California clapper rail, black rail, salt marsh harvest mouse, and Suisun shrew also depend on it.

Gill (1979) reported that DFG did not believe California clapper rails to be in Suisun Marsh. However, Harvey (1980) conducted surveys of California clapper rails in Suisun Marsh in 1978 under contract to DFG, and confirmed the presence of 25 breeding pairs in the Cutoff Slough marshes.

DWR and DFG personnel have detected California clapper rails at Cutoff Slough, First Mallard Branch, Second Mallard Branch, Montezuma Slough at Joice Island, Hill Slough, Peytonia Slough, the mouth of Boynton Slough, Ryer Island, Point Edith Marsh, Suisun Slough at Morrow Island, and the Suisun Bay shoreline at Suisun Marsh Reserve Fleet (also known as the "mothball fleet") (DWR 1994). Detailed maps of California clapper rail locations in Suisun Marsh are presented in *Summary of Sensitive Plant and Wildlife Resources in Suisun Marsh During Water Years 1984-1994* (DWR 1994).

California clapper rails were reported in the Cutoff Slough marshes of Suisun Marsh by the Napa-Solano Audubon Society during the Benicia Christmas Bird Count in the 1970s. These unconfirmed winter reports prompted the first comprehensive breeding season survey for California clapper rails in Suisun Marsh undertaken by Tom Harvey in 1978. Harvey (1980) documented 25 breeding pairs of California clapper rails along the Cutoff Slough marshes (Rush Ranch and DFG lands).

California clapper rails have consistently been detected in the Cutoff Slough marshes during Christmas bird counts and breeding season census (DWR 1994). California clapper rails have also been consistently detected at the Suisun Marsh Reserve Fleet shoreline northeast of the Benicia-Martinez bridge. Breeding populations of California clapper rails were detected at Hill Slough by DWR and DFG staff in 1992 (Brenda Grewell and Laurie Briden, field observations; DWR 1994). There were no records of California clapper rail census in this area prior to the 1992 detection, but mosquito abatement district personnel indicate the California clapper rails been heard and seen in the Hill Slough marshes since the early 1980s. California clapper rails have also been documented at the mouth of Boynton Slough and Suisun Slough at Morrow Island during the breeding season. A California clapper rail carcass was discovered north of Peytonia Slough in summer 1992 (Brenda Grewell, field notes). Dave Feliz (DFG) detected California clapper rails at Peytonia Slough Ecological Reserve during the Christmas bird counts (Leong, personal communication, see "Notes"). Repeated incidental sightings of California clapper rails have been made by DWR and DFG staff biologists in late summer along Suisun Slough. There appears to be California clapper rail movement along the Suisun Slough corridor at the close of breeding season when juvenile rails are dispersing from nesting territories. There have been no California clapper rail detections east of Hill Slough, the Beldons Landing Bridge on Montezuma Slough, or east of Ryer Island and Middle Point on the Contra Costa shoreline, though these areas were searched by Harvey and DWR and DFG staff.

Project Impacts

The following Amendment Three actions are not expected to affect the California clapper rail.

- Drought Response Fund.
- Updating management plans.
- Morrow Island Distribution System and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repairs.

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

It is uncertain whether channel water salinity standards in the 1995 Water Quality Control Plan will affect California clapper rails. Field observations suggest that sustained increases in water levels associated with high Delta outflow, as experienced in water years 1996 through 1998, may dramatically reduce the time and extent of exposure of California clapper rail foraging habitat. Sustained high outflow conditions also have the potential to affect California clapper rail nests due to their proximity to tidal sloughs and creeks. However, these were years with exceptionally high outflow during years of high precipitation and outflows associated with the channel water salinity standards in the 1995 Water Quality Control Plan are not as high or for as long as flood flows from 1996 through 1998. Regardless, careful experimental and monitoring studies are needed to determine whether actions needed to comply with the 1995 Water Quality Control Plan will have a negative effect on endangered California clap-per rails. These data are not currently avail-able.

Converting S-35 and S-97 to Monitoring Stations

Converting S-35 and S-97 to monitoring stations may enhance potential California clapper rail habitat, as implementation of D-1485 salinity standards in the western marsh may eliminate suitable tidal marsh habitat for California clapper rails (USFWS 1994f). Knowledge of the basic ecology of this species

suggests that aqueous salinity regimes which vary with water year types could be more beneficial to both tidal marsh species diversity and rare species persistence.

Establishing Criteria for September SMSCG Operations

Because there is currently no scientific data that evaluates the influence of physical and biological processes on Suisun tidal marsh plant communities, the magnitude of the effect of SMSCG operations is unknown. The goal of September SMSCG operations is to freshen channel water salinity prior to flooding of lands for wintering waterfowl. Channel water salinity in Suisun Marsh is historically highest in September, prior to onset of the fall rainfall. The incremental change in salinity and associated increases in water elevations during this time have the potential to affect California clapper rail food resources. The details, direction, and extent of this effect are unknown.

Managed Wetlands Improvement Fund

It is unlikely that actions funded by the Managed Wetlands Improvement Fund would affect California clapper rails because these actions would all occur on diked wetlands. California clapper rails are not likely to use diked wetlands except as refugia from high tides. In areas where California clapper rails are restricted to fringing marsh along the outboard side of levees, actions such as ditch construction or vegetation clearing during high tide periods may affect them.

The installation of new drainage structures may affect the California clapper rail although the USFWS biological opinion (1995) addresses disturbance to California clapper rails during construction activities and sets specific restrictions to work allowed in the proximity of California clapper rail habitat to avoid negative effects during the breeding season.

Joint-use Facilities Program

Most of the actions associated with the Joint-use Facilities Program would not affect the California clapper rail. However, installing new drainage gates may affect this species. The USFWS biological opinion (1995) addresses disturbance to California clapper rails during construction activities and sets specific restrictions to work allowed in the proximity of California clapper rail habitat to avoid negative effects during the breeding season. Disturbance outside of the breeding season is still a potential affect to California clapper rails, as rails may respond by dispersing between suit-able habitat fragment patches resulting in increased predation losses. California clapper rails have been known to leave territories during construction disturbance in Suisun Marsh and San Francisco Bay (Browning, personal communication, see “Notes”).

Portable Pumps Program

Operation of the portable pumps would not affect California clapper rails. Potential effects to California clapper rails resulting from the installation of a new discharge location for the pump could be avoided by following the restrictions in the 1995 biological opinion.

Water Manager Program

The Water Manager Program may affect California clapper rails. This potential effect is expected to be minimal because California clapper rail use of diked wetlands appears to be associated with escape from high tides outside of extensive undiked tidal wetland areas. Habitat changes associated with implementation of the Water Manager Program are not likely to jeopardize this species.

Critical Habitat

Although there is no official clapper rail designated habitat, the USFWS has identified several areas within the Suisun Marsh that

California clapper rails are known to nest including (1) Hill Slough, (2) Rush Ranch (Cutoff Slough), (3) Goodyear Slough and Suisun Bay, adjacent to the Mothball Fleet, and (4) tidal marshes of the southwest side of Suisun Slough and Suisun Bay from the mouth of Goodyear Slough south to the Mothball Fleet. The USFWS described these areas in a letter dated 2 May 1994 and provide maps identifying these locations (USFWS 1994f).

Existing Environment and Cumulative Effects

Reduction of tidal marsh habitat, estimated at 85% to 95%, has been the major historical cause of rail decline (Foin and others 1997). The lack of quality marsh habitat has further limited populations of this species (Foin and others 1997). Predation of California clapper rails by the introduced red fox has decimated San Francisco Bay populations (Foerster and others 1990).

Disturbance from construction activities has caused California clapper rails to abandon territories. This behavior was documented at the Suisun Marsh Reserve Fleet shoreline during construction of the new causeway. California clapper rails returned to the shoreline following construction (Burch, personal communication, see "Notes"). California clapper rails are extremely vulnerable to predation when forced to move between habitat fragments.

California clapper rails are also vulnerable to oil spills. A substantial breeding population of California clapper rails has been documented at Point Edith Marsh. This marsh was affected by the Shell oil spill in 1988, and small oil spills frequently occur in the Carquinez Straits. California clapper rails are vulnerable to direct contact with oil, and these mud-probing feeders are vulnerable to food chain magnification of toxic chemicals. California clapper rails are also threatened by exposure to excessive census activities with taped calls. Census activities at high tides unnecessarily expose these birds to aerial predators. Active census activities during breeding season can also move birds from nests which subject them to nest predation. Conservative guidelines have been established for permitted, professional biological census activities, but amateur and untrained census activities with taped calls can continue to jeopardize these rare birds.

The response to a request of USFWS for informal consultation and approval of the 1994 Western Suisun Marsh Salinity Control Test included a discussion of the relevance of the salinity standards for maintaining appropriate fish and wildlife habitat in the western Suisun Marsh (USFWS 1994f). The consultation concluded that the D-1485 salinity standards for the western marsh were designed to guarantee freshwater flows that would reduce salinity and enhance the physical environment for waterfowl food plants. The USFWS further stated that the salinity standards did not enhance the physical environment for salt tolerant species used by the federally listed salt marsh harvest mouse. Furthermore, USFWS stated that long term maintenance of the D-1485 salinity standards may decrease or eliminate suitable tidal marsh habitat for federally listed species, such as California clapper rails, thus perpetuating their decline (USFWS 1994f).

There are no perceived cumulative effects to California clapper rails relative to Amendment Three of the SMPA.

Conclusion and Determination

California clapper rails are present in Suisun Marsh today and there is evidence to suggest that they have occupied Suisun Marsh for some time. While California clapper rail populations in Suisun Marsh are small, the presence of this species at the extreme end of its histori-

cal range could be of critical importance to its persistence and recovery. Furthermore, California clapper rails are in areas where red fox has yet to be detected. This further underscores the importance of maintaining viable populations of these rare birds in Suisun Marsh.

Implementation of the 1995 Water Quality Control Plan may potentially affect California clapper rails. The effects of the actions of this plan on Suisun Marsh species that rely on halophytic plant communities has not been fully addressed. Actions proposed for improvement of waterfowl habitat landward of Suisun Marsh levees are expected to have minimal to no effect on the species because it only occasionally uses these lands as high tide refugia. Some Amendment Three actions, such as converting S-35 and S-97 compliance stations to monitoring stations, are expected to enhance and maintain habitat for California clapper rails.

California Least Tern, Sterna antillarum browni

Status

Numbers of the California subspecies of least terns have declined substantially since the 1930s due primarily to human development of coastal breeding sites, but also to recreational disturbance and introduced predators (Harvey and others 1992; Small 1994). From the estimated thousands of least terns that historically nested in California, less than 2,000 pairs have bred in recent years. For this reason, the California least tern was listed as endangered under the federal Endangered Species Act and the California Endangered Species Act in 1970. Their status remains unchanged.

Distribution

California least terns are coastal breeders occurring from the San Francisco Bay Area southward into northern Baja, Mexico (Small 1994; Harvey and others 1992). Known breeding sites around the San Francisco Bay Area counties include four in Alameda, two in Contra Costa and two in San Mateo (Collins 1987; Atwood and others 1979; Feeney and Collins 1985; Carter and others 1990, all as cited in Harvey and others 1992). As many as 89 pairs may have attempted nesting within the San Francisco Bay Estuary in 1990 (Carter and others 1990, as cited in Harvey and others 1992).

The wintering distribution of least terns is not well described, however, no known overwintering occurs in California (Root 1988). On the Pacific coast least terns are known to winter from Baja to southern Mexico and possibly as far south as southern Central America (Ehrlich and others 1988). On the Atlantic coast they have been observed as far north as North Carolina and as far south as Brazil (Root 1988). The pacific coast wintering population probably includes the California subspecies.

Habitat

California least terns historically nested primarily on sandy outer coastal beaches but also within estuaries, lagoons, and bays and along freshwater lakes and ponds near the coast (Ehrlich and others 1988). Due probably to loss of much of their natural habitat, breeding now may also occur at artificial sites, including some open areas with a sandy or hardpan surface, aircraft runways, and abandoned salt and other diked managed ponds (Ehrlich 1988; Harvey and others 1992; Small 1994). Wintering habitats are coastal areas from Baja to southern Mexico (Root 1988). Foraging habitat is shallow open water.

Habitat occurring within Suisun Marsh that may be used by California least terns includes open natural or artificial sandy areas, including dry pond bottoms and the sandy margins of the bay and sloughs where nesting could potentially occur. Foraging habitat consists of open water areas nearby potential nest sites.

General Ecology

Least terns are the smallest of the tern species. California least terns are mostly colonial breeders, though solitary pairs have been observed (Ehrlich and others 1988). Nests are simple, usually consisting of an unlined depression in the sand. Because they nest on the ground, least terns are highly susceptible to disturbance, which often results in colony abandonment. Spring arrival in the San Francisco Bay Area usually occurs by late April (Small 1994). Fall migration begins in late August. Most birds are gone by mid-September though a few may remain until late Octo-

ber. The diet of California least terns consists of small fish, crustaceans and insects (Ehrlich and others 1988).

Least terns are declining throughout most of their range (Ehrlich and others 1988). Approximately only 20 breeding colonies presently occur in California between San Francisco and San Diego counties (Small 1994). In the San Francisco Bay Estuary several low salinity salt ponds in Alameda and Santa Clara counties serve as post fledging, pre-migratory staging areas where juveniles hone fishing skills (Harvey and others 1992). Least terns begin breeding at two years of age (Ehrlich and others 1988).

Occurrence in the Project Area

California least terns are not known to occur in the project area though potential nesting habitat is available and breeding occurs nearby within the San Francisco Bay Estuary. Because surveys to identify least tern occurrence in the project area have not been conducted, it is unreliable to assume the species' presence or absence. Furthermore, because least terns have colonized novel sites within the San Francisco Bay Estuary in recent years, new nesting attempts within the project area would be possible.

Project Impacts

The following actions included in Amendment Three are not expected to affect California least terns.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Operation and maintenance of Existing Facilities.
- Establishing criteria for September SMSCG operations.
- Morrow Island and Lower Joice Island fish screens (provided a breeding colony is not located at the sites during installation).
- Roaring River Distribution System turnout repair (provided a breeding colony is not located at the site during repairs).
- Water Manager Program.
- Portable Pumps Program.

The following actions included in Amendment Three could affect California least terns should they attempt to nest in the project area.

Drought Response Fund

This action would provide funds for management activities such as discing, creation of V-ditches, and operation of portable pumps. Activities such as ditching and discing in or nearby a least tern colony could cause nesting failure and colony abandonment. However, there should be no impacts to least terns provided they are not present in the project areas during activities.

Managed Wetlands Improvement Fund

75/25 Cost-share Program. This program will replace or improve drainage facilities and allow for better control of hydroperiod and leaching cycles. Construction activities occurring in or adjacent to a least tern colony could cause nest failure and colony abandonment. Nest failure could also occur should pond flooding inundate nests. However, there should be no impacts to least terns provided they are

not present in the project areas during activities.

50/50 Cost-share Program. This program will facilitate the construction and maintenance of water delivery systems, such as ditches in the managed wetlands, and could include the raising of pond bottom sinks and levee coring. Least terns are not likely to use levees, but may use pond bottoms where they would be directly affected should nests be buried during elevation alterations. Nesting failure could also occur should pond flooding inundate nests. However, there should be no impacts to least terns provided they are not present in the project areas during activities.

Update Management Plans

This action will fund efforts to write new management plans for private ownerships in the marsh. While this action in itself will not cause impacts, activities recommended in the plans may result in increased activities like ditching, discing and leach cycles. Changes in soil water salinity should not affect California least terns. Water level changes associated with leaching, however, would likely cause nest failure should nests become submerged. However, there should be no impacts to least terns provided they are not present in the project areas during activities.

Joint-use Facilities Program

This action incorporates many of the above-mentioned management activities and facilities construction into a plan for the joint use of facilities by neighboring property owners. Should one be present, activities occurring in or adjacent to a least tern colony would likely cause nesting failure and colony abandonment. Water level changes associated with leaching could also cause nest failure should nests become submerged. However, there should be no impacts to least terns provided they are not present in the project areas during activities.

Impacts to California least terns could occur should the species attempt to breed within the project area while management activities are conducted. The presence or absence of least terns should, therefore, be considered prior to project actions that could affect them.

Critical Habitat

There is no designated critical habitat for California least terns in the project area.

Existing Environment and Cumulative Effects

Because California least terns are not known to occur in the project area, cumulative effects are difficult to estimate. Potential current (human-caused) negative impacts to least terns, and their habitat in Suisun Marsh include but are not limited to the following.

- Possible direct human disturbance, including any activities occurring in areas where least terns are nesting.

- Elimination of potential breeding habitat as a result of management activities to increase waterfowl habitat.

Conclusion and Determination

California least terns are not known to nest within the project area. However, because of their sensitive status, and the presence of breeding colonies nearby within the San Francisco Bay Estuary, potential for impacts to the species should be considered prior to conducting project activities. Some Amendment Three actions have the potential to affect least terns, should they be present, through direct disturbances to breeding colonies. Should least terns occur within the project site, avoiding or delaying activities that could directly affect the colony would substantially reduce potential negative impacts to the bird.

Chapter 7
REPTILES

Western Pond Turtle, *Clemmys marmorata*

Status

The western pond turtle includes two subspecies, the northwestern pond turtle (*C. m. marmorata*) and the southwestern pond turtle (*C. m. pallida*). Both subspecies were petitioned for federal listing on 29 January 1992. On 5 October 1992, the USFWS announced its 90-day finding stating that the petition presented sufficient information to indicate that listing may be warranted. The formal review process was then initiated. In 1993, the USFWS determined that there was insufficient information to propose listing of the species. The western pond turtle is now a federal species of special concern. The DFG considers the western pond turtle to also be a California species of special concern.

Distribution

The western pond turtle occurs in suitable aquatic habitats throughout California, west of the Sierra Nevada, and in parts of Oregon and Washington. The northwestern pond turtle is found north of San Francisco Bay, while the southwestern pond turtle is found south of San Francisco Bay. There is evidence to suggest that the two subspecies may intergrade between the San Francisco Bay region and the San Joaquin Valley. Suisun Marsh may be inhabited by a hybrid of the northwestern and southwestern subspecies (Holland and Bury, personal communication, see “Notes”).

Systematic boat surveys of sensitive species habitat have been conducted by DWR staff throughout Suisun Marsh since 1991. These surveys have focused on the detection of sensitive plant and bird species, but observations of pond turtles have been recorded. Western pond turtles have been observed basking on mud banks adjacent to Hill Slough, Nurse Slough, Cutoff Slough, First Mallard Branch, Second Mallard Branch, Boynton Slough, Peytonia Slough, Frank Horan Slough, and Cordelia Slough. They have also been observed along Grizzly Slough (an internal distribution ditch on Grizzly Island), along Roaring River, and ditches in managed wetlands.

Habitat

The western pond turtle is a habitat generalist found in both seasonal and permanent aquatic habitats ranging from fresh water to sea water, with a high tolerance to brackish conditions (Holland 1991). Western pond turtles are found near a wide variety of wetlands, including ponds, marshes, lakes, streams, rivers, irrigation ditches, and vernal pools. Aquatic habitats with slow currents, adequate vegetative cover, and sunny basking sites (logs, exposed banks, and mudflats) are favored. Hatchling and first-year turtles require shallow water, emergent vegetation, and woody debris such as hanging branches and downed snags (Holland 1991). In the marsh, pond turtles are most commonly observed basking on the banks of channels during daylight low tides.

General Ecology

Pond turtles are diurnal, but some are crepuscular, and nocturnal activity has been observed. The turtles become most active

when water temperatures are above 15 °C. Basking and other thermoregulatory behaviors are used to maintain a body temperature near 32 °C (Bury and Holland forthcoming). Individuals are active all year where climates are warm but in the northern parts of the range they hibernate during cold periods. The turtles may hibernate underwater in the mud, or they may move into upland habitats (Morey 1985; Storer 1930). Pond turtles are omnivorous generalists and opportunistic predators, eating primarily aquatic invertebrates and vegetation plus small vertebrates and carrion (Bury and Holland forthcoming).

Pond turtles grow slowly; they may take up to 12 years to reach sexual maturity, and may live for 30 to 40 years. Mating has been observed from May to September, but all observed ovipositions occurred from May to July. A female may only lay eggs every other year (Bury and Holland forthcoming). Females build nests along wetland margins or in adjacent uplands, usually from 15 to 190 m from water (Rathbun and others 1992). Oviposition requires soil which is at least four inches deep, and usually takes place in a southern exposure at a site which will not flood. Most observed nests have been on dry, well-drained soils with significant clay and silt content and low slope (Holland 1991). Incubation is about 12 weeks. There is some indications that hatchlings may overwinter in the nest, emerging for the first time in March or April (Holland 1991). Young turtles are preyed upon by introduced predators such as bullfrogs and bass (Bury and Holland forthcoming).

The western pond turtle is not known to be territorial, but aggressive encounters including gesturing and physical combat (Bury and Wolfeim 1973) are common and may function to maintain spacing on basking sites and to settle disputes over preferred spots. The species is fairly sedentary, with home ranges of approximately one hectare for males and 0.3 hectare for females, but they can move considerable distances (1.5 km or more) usually within the same drainage (Holland 1991).

Pond turtles are secretive and usually submerge themselves at the slightest disturbance, making them difficult to observe or effectively count.

Occurrence in the Project Area

Western pond turtles have been observed along sloughs and waterways throughout the Suisun Marsh. In the managed wetlands, turtles are seen primarily during spring draw-down, basking on pipes or debris in the larger drainage ditches (Steve Chappell, personal communication, see “Notes”). It is not known where the turtles overwinter in the marsh, where they nest, or where favored habitats of hatchlings and juveniles occur.

Project Impacts

In general, Amendment Three actions are not expected to have any significant effects to western pond turtles or their habitat. Most observations of turtles in the marsh have been along slough margins, and not in the managed wetlands where most Amendment Three actions will take place.

The following Amendment Three actions are not expected to affect the western pond turtle.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Establishing criteria for September SMSCG operation.
- Lower Joice Island fish screen.
- Updating management plans.

Converting S-35 and S-97 to Monitoring Stations

This action may result in temporary and seasonal increases in western marsh channel water salinity and is not expected to adversely affect the western pond turtle because the species is tolerant of a wide salinity range, including full-strength sea water (Holland 1991).

Managed Wetlands Improvement Fund

75/25 Cost-share Program

This program will replace or improve drainage facilities and may have minor, temporary effects to western pond turtle habitat. Installation of the facilities may remove emergent vegetation, disturb mudflat basking areas, and increase turbidity in the water column. Disturbances within the seasonal wetlands will not affect the species, as these wetlands will be dry when facilities are installed.

50/50 Cost-share Program

This program will facilitate the construction of water delivery systems such as ditches in the managed wetlands. Construction would only occur when the ponds are dry, so there will be no direct effects to the western pond turtle. There may be minor, temporary effects if ditch cleaning or construction removes substantial amounts of emergent vegetation.

Drought Response Fund

This action would provide funds for management activities such as discing, creation of V-ditches, and operation of portable pumps. These activities in the managed wetlands are not expected to have substantial effects to the turtle. There may be some loss of emergent vegetation that may have minor temporary effects on turtle use the following season.

Morrow Island Fish Screens

The installation and maintenance of fish screens may have temporary effects to pond turtles. There may be temporary increases in local turbidity associated with installation and annual maintenance. Resident turtles will be disturbed by activities around the screens, and basking and feeding behaviors may be temporarily disrupted. Installation may temporarily remove emergent vegetation and disturb basking sites adjacent to the screens.

Roaring River Distribution System Turnout Repairs

Roaring River Distribution System turnout repairs may disturb the waterside of the levee where the pipes enter the distribution system, emergent vegetation may be temporarily removed, and basking sites temporarily disturbed. There may be temporary increase in local turbidity during the repairs.

Water Manager Program

The primary goal of the Water Manager Program is to ensure water management to limit peaks in soil water salinity and changes in soil water salinity will not affect the western pond turtle. It is not known what effects water level changes associated with leaching would have on the turtle. There may be some disturbance to basking turtles due to vehicular traffic and increased visits to intake and drainage facilities.

Joint-use Facilities Program

This action incorporates many of the above-mentioned management activities and facilities construction into a plan for the joint use of facilities by neighboring property owners. Minor, temporary effects to turtles may occur due to installation of drain or intake gates (temporary loss of emergent vegetation on slough-side of levees, disturbance of mudflat basking areas, increased turbidity), ditching (temporary loss of emergent vegetation in seasonal wetlands), and increased management activities like leaching.

Portable Pumps Program

The use of portable pumps is not expected to affect the western pond turtle; there is no evidence that turtles are directly affected by pump operation. The noise of pump operation may disturb turtles basking in areas adjacent to the pump.

Critical Habitat

There is no designated critical habitat for the western pond turtle in the project area.

Existing Environment and Cumulative Effects

Current and ongoing (human-caused) negative effects to the pond turtle and its habitat in Suisun Marsh include the following.

- Boat wakes which disturb basking turtles and erode channel banks.
- Direct human disturbance from vehicles and management activities, such as installation and operation of water delivery facilities.
- Temporary loss of habitat due to removal of vegetation and bank disturbance due to management activities, levee maintenance and repair, dredging, and other construction.

Conclusion and Determination

Amendment Three is not expected to significantly affect the western pond turtle or its habitat in the Suisun Marsh.

Chapter 8
AMPHIBIANS

California Red-legged Frog, *Rana aurora draytonii*

Status

The California red-legged frog was listed as threatened by the USFWS in 1996. It is also a DFG California species of special concern.

Distribution

The historical range of the California red-legged frog extended coastally from Point Reyes and inland from Redding, southward to northwestern Baja California. Its current range is much reduced, with most remaining populations occurring in central California along the coast from Marin County south to Ventura County (Jones and Stokes 1996).

Habitat

In general, dense vegetation close to and shading slow-moving water of moderate depth are habitat features that appear especially important to California red-legged frogs (Hayes and Jennings 1988). The frogs occur in different habitats depending on their life stage and the season. All stages are most likely to be encountered in and around breeding sites, which include coastal lagoons, marshes, springs, permanent and semipermanent natural ponds, ponded and backwater portions of streams, stock ponds, irrigation ponds, and siltation ponds. Creeks and ponds where the frogs are found often have deep pools, dense and overhanging growth of woody riparian vegetation, especially willows (*Salix*), an understory of cattails (*Typha*) and tules (*Scirpus*), and sandy or silty streambeds (Hayes and Jennings 1988). The absence of *Salix*, *Typha*, or *Scirpus* at an aquatic site does not rule out the possibility of the frog occurring there, but the presence of one or all of these plants is an important indicator that the site may provide foraging or breeding habitat (USFWS 1997).

Eggs are found in ponds or pools attached to emergent vegetation. The tadpoles remain in these habitats until metamorphosis in the summer. Young frogs can occur in slow-moving, shallow riffle zones in creeks or along the margins of ponds. In the summer, older frogs are often found close to a pond or a deep pool in a creek where emergent vegetation, undercut banks, or semi-submerged rootballs afford shelter from predators. Throughout the year, adult frogs may also take shelter in small mammal burrows and other refugia on the banks up to several dozen meters from the water and can be found in smaller, often ephemeral bodies of water, such as seeps or springs, in a variety of upland areas. The frogs often move away from the water after the first winter rains, sometimes as far as 1.5 km (USFWS 1997).

General Ecology

The California red-legged frog is a relatively large aquatic frog, ranging from 4 to 13 cm from snout to vent. The skin is usually smooth, and the dorsal color can be brown, gray, olive, or orange, with a pattern of dark flecks. The undersides of adults are white, usually with patches of red or orange on the abdomen and hind legs.

Sexual maturity is reached at three to four years of age, and frogs may live eight to ten years (USFWS 1996). California red-legged frogs breed from late November through April. Females deposit from 2,000 to 6,000 eggs, two to three millimeters in diameter, in a loose mass attached to emergent vegetation near the surface of the water. Eggs hatch in 6 to 14 days, and transform into juvenile frogs in 3.5 to 7 months.

Juvenile and adult red-legged frogs are sit-and-wait predators that are apparently cued by continuous movement of the prey item. Although juveniles have been observed feeding during the day, adults are active primarily at night. Adults feed on the surface of the water in algal mats and in dense shoreline vegetation. They consume a wide variety of terrestrial and aquatic vertebrates and invertebrates, including beetles, sowbugs, worms, spiders, water striders, flies, snails, small frogs, and small mice (Hayes and Tennant 1984; USFWS 1997). Tadpoles feed on decomposed plant and animal material, green algae, diatoms, and bacteria (Storer 1925).

Occurrence in the Project Area

Suisun Marsh is within the historical range of the California red-legged frog, although there are only anecdotal records of the frog along Montezuma Slough (Neitzel 1965). Recent surveys (Shaffer, personal communication, see "Notes") have not located the frog in the marsh, but they are known in upland freshwater areas bordering the marsh (McCaslan, personal communication, see "Notes"). Suisun Marsh is believed to be too saline to serve as breeding habitat for the frog (Jennings and McCaslan, personal communications, see "Notes"); eggs and larvae cannot survive in salinities greater than 4.5 ppt (approximately 7 mS/cm) and 7 ppt (approximately 11 mS/cm) (Federal Register, 23 May 1996). Adult frogs can tolerate mild salinities and may disperse through the marsh.

Project Impacts

If the frog occurs in the Suisun Marsh, it would most likely be in its margins, where local creeks flow into it and water salinity is very low. None of the proposed Amendment Three actions would affect these areas. Areas with substantial tidal action are probably too saline to be occupied by the frog's breeding populations.

Critical Habitat

There is no designated critical habitat for the California red-legged frog in the project area.

Existing Environment and Cumulative Effects

If the frog was historically present within the marsh, its extirpation was probably due to a combination of factors that have led to its decline throughout the State. These factors include habitat loss and alteration, overexploitation, and introduction of exotic predators. The frogs that are known from the area west of Highway 680 are at risk from development. Many problems have been documented in streams north of them due to siltation caused by increased runoff from newly-constructed subdivisions.

Conclusion and Determination

The California red-legged frog is not known to occur within the Suisun Marsh. If it does occupy areas of the marsh, the proposed Amendment Three actions are not expected to adversely affect the species.

Chapter 9
FISH

Chinook Salmon, *Oncorhynchus tshawytscha*

Status

There are four runs of chinook salmon that are distinguished by the timing of upstream migration and the spawning season. The runs are named for the season during which the adults enter fresh water. Three of these runs (winter-run, spring-run, and fall-run) are of special concern and are discussed below. In 1989, the Sacramento River winter-run chinook salmon was listed as threatened under the federal Endangered Species Act by NMFS (54 FR 32085). NMFS reclassified the winter-run as endangered in 1994 (59 FR 440). In 1993, NMFS designated critical habitat for the winter-run chinook from Keswick Dam (Sacramento river mile 302) to the Golden Gate Bridge (58 FR 33212). Central Valley spring-run chinook salmon was listed as threatened in August 1998. Fall-run chinook salmon and their critical habitat are proposed threatened.

Distribution

The chinook salmon has the broadest geographic range of the seven Pacific salmon species. Runs of chinook salmon are found throughout the northern Pacific Ocean and tributary drainages around the Pacific Rim from northern Japan to southern California (Vogel and Marine 1991). In spite of its wide distribution, the chinook salmon is the least abundant of Pacific salmon species in North America. Numbers of this native, anadromous species, which is distinguished by its highly variable life history and multiple stocks, are maintained to a large extent by hatchery production (DWR 1993; SFEP 1992a).

The Central Valley supports the largest population of chinook salmon in the State (SFEP 1992a). The bay-delta estuary serves as a migratory corridor for migrating adults and emigrating smolts, and serves as rearing habitat for salmon fry. All four runs of chinook salmon spawn in the upper Sacramento River.

Habitat

After maturing in the ocean, adult salmon migrate through the estuary to spawn (SFEP 1992b). Acceptable water temperatures for the upstream migration of adults range from 57 °F to 67 °F. Spawning historically occurred in Central Valley streams that provided approximately 6,000 miles of habitat for spawning (SFEP 1992b). However, dam construction in the Central Valley has reduced the quantity of habitat available to spawning salmon: only about 300 miles of the original instream habitat remain. At present, most spawning occurs in the upper Sacramento River from Keswick Dam southward (Wang 1986). Spawning generally occurs in swift, relatively shallow riffles or along the edges of fast runs where there is an abundance of loose gravel.

Spawning requires well-oxygenated cool water that percolates through the gravel and supplies oxygen to developing embryos. The preferred temperature for chinook salmon spawning is approximately 52 °F, with lower and upper threshold temperatures of 42 °F and 56 °F. Temperatures above this range result in reduced viability of eggs or heavy mortality of developing juveniles. Total egg mortality normally occurs at 62 °F. The eggs usually hatch

in 40 to 60 days, if the water temperature is within the appropriate range. The young sac-fry remain in the gravel for an additional four to six weeks until the yolk sac is absorbed. After emergence, chinook salmon fry feed in low velocity slack water and back eddies. They move to higher velocity areas as they grow larger and eventually migrate to the ocean as smolts. Young salmon remain in the ocean until their third or fourth year, at which time they return to their home stream to spawn. A small percentage of "jacks" return to fresh water as one- or two-year-olds.

General Ecology

The chinook salmon life history cycle involves adult migration from the ocean to freshwater streams to spawn and juvenile migration out to sea during the first year of life. Timing of adult migration differs depending on the race or run. The different runs are named for the time of year during which they enter fresh water to spawn (SFEP 1992b). Winter-run chinook move upstream between January and June and begin spawning in April. Spring run chinook salmon move upstream between March and July and begin spawning in August. Fall-run chinook salmon enter fresh water between July and November and begin spawning in October. Late-fall run chinook salmon move upstream between October through February and begin spawning in January. After hatching, young salmon move downstream and through the Sacramento-San Joaquin Delta before passing through the San Francisco Bay system and entering the ocean.

Many interacting factors are believed to be responsible for the decline in chinook salmon populations. Abundances have decreased due to human effects, such as building dams and water diversions, logging practices, and pollution. High mortality can occur during early life stages due to habitat destruction, redd destruction, siltation, extreme water temperatures, low dissolved oxygen, loss of cover, disease, competition, and predation.

Occurrence in the Project Area

Adult chinook salmon migration in the vicinity of Suisun Marsh and Bay varies for each race of salmon. Adult winter-run migrate through Montezuma Slough and Suisun Bay from November through mid-June, with peak occurrence in the marsh from February through April (Holsinger, personal communication, see "Notes"). Juveniles may occur in the marsh from September through May, with especially high numbers occurring from January through April. Adult spring-run may occur in the Montezuma Slough or Suisun Bay from February through June, with the peak migration occurring in May (Harvey, personal communication, see "Notes"). Juveniles may be migrating through the marsh December through May. Fall-run adults may occur in the area June through December, while juveniles may be present from January through July, with the peak occurrence from February through mid-May.

The presence of juvenile chinook salmon in the marsh has varied over the past 15 years, according to the results of the UC Davis sampling (DWR 1997a). Chinook salmon were captured in trawls in all but two years between 1980 and 1989. No chinook salmon were captured subsequently until 1995, when a total of 50 individuals were collected (48 in beach seines and two in trawls) (Matern and others 1996). In 1996, a total of seven chinook salmon were captured, while in 1997 only one chinook salmon was caught. All chinook salmon from 1995 and 1996 were captured between January and April and all were identified as fall-run using Frank Fisher's length-at-date criteria. Most of these fish were captured with a beach seine in Denverton Slough. Since 1980 annual mean abundance of chinook

salmon has ranged from 0 to 0.08 fish per trawl (DWR 1997a).

Project Impacts

The following Amendment Three actions will not affect any runs of chinook salmon because they would be conducted exclusively in the managed wetlands or use structures that are equipped with fish screens.

- Managed Wetland Improvement Fund.
- Drought Response Fund.
- Roaring River Distribution System turnout repairs.
- Updating management plans.

Actions that could potentially affect the three runs of chinook salmon are described below, including several actions which will not affect the runs, but for which explanation is helpful.

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

The potential affects to special status species were addressed in the Environmental Report (Appendix 1) of the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 1995). SWRCB concluded that the standards should preserve a salinity gradient within the unmanaged tidal marshes of the estuary, including the Suisun Marsh. The proposed increases in freshwater outflow are within the historical salinity ranges and are not expected to adversely affect any of the three sensitive runs of chinook salmon.

The proposed Amendment Three channel salinity standards should not affect the natural (east-west and north-south) salinity gradient in the marsh. The salinity standards are upper limits, as are those required by SWRCB permit conditions in Orders WR 95-6 and 98-9. These standards do not establish lower salinity limits. Except in very wet years, the natural salinity gradient would be higher in the western marsh as expected under the natural gradient. In addition, the original SMPA and water right permit standards do not interfere with the natural gradient because they provide for defined “deficiency periods” with appropriate relaxation of standards. These standards allow for increased salinity in the western marsh during drier years as would occur under a natural salinity gradient. Implementation of these standards would not affect any of the runs of chinook salmon.

Converting S-35 and S-97 to Monitoring Stations

By converting S-35 and S-97 to compliance stations, channel water salinity in the western marsh would, at times, be higher than Order WR 98-9 standards. This would have no effect on any of the three runs of chinook salmon, nor would it adversely modify or destroy critical habitat. Juvenile and adult chi-nook salmon have a wide salinity tolerance range (> 0 ppt) and thus will not be affect by higher channel water salinities in the western marsh.

Establishing Criteria for September SMSCG Operations

This proposal could adversely affect any runs of chinook salmon which migrate through the marsh in September. The runs that may be in Montezuma Slough during September are winter-run juveniles, which may move through Montezuma Slough between September and May, and fall-run adults which may migrate through the slough between June and December (Holsinger, personal communication, see “Notes”). See the previous discussion about the effects of SMSCG operations on adult chinook salmon.

Adverse effects to adult chinook salmon may be avoided by mitigation measures, such as modifications to flashboards that would enable

chinook to pass unimpeded. If such mitigation measures are pursued, this action would not likely have adverse effects to any of the runs of chinook salmon.

Morrow Island Distribution System Fish Screens

This action may benefit chinook salmon and other fish in the marsh. Placing a fish screen on the intake to the Morrow Island Distribution System will decrease the number of fish diverted into the system and entrained by the intakes, thus preventing mortality due to entrainment.

Lower Joice Island Unit Fish Screen

This action may benefit chinook salmon and other fish in the marsh. Placing fish screens on the Lower Joice Island Unit will decrease the number of fish diverted into the system and entrained by the intakes, thus preventing mortality due to entrainment.

Water Manager Program

This action could benefit chinook salmon. The water manager is responsible for monitoring the flood and drain periods to ensure that the properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS. This will prevent unnecessary diversions from the sloughs and bays and help protect resident and anadromous fish such as delta smelt, splittail, and chinook salmon. The water manager would monitor the operation of fish screen facilities on private property and perform routine maintenance to ensure that screen operation is in compliance with design criteria for the facility. By decreasing the possibility of fish entrainment, this action may benefit chinook salmon.

Joint-use Facilities Program

Circulation and drainage ditch maintenance, coring of common levees, and excavation of new circulation ditches would occur inside the managed wetlands, so there would be no adverse effects to any chinook salmon runs.

Increased turbidity due to installment of exterior drainage gates could affect chinook salmon movement. However, to avoid adverse effects, new exterior drainage gates would be installed within one low tide, without excavation or in-water work. Thus, this work will not adversely affect chinook salmon or other anadromous fish.

New exterior drainage gates may incrementally increase the amount of drainage water entering the tidal sloughs. Changes in salinity concentration might occur if several land areas drain into a small slough simultaneously. Such effects should be minimal because the resulting salinity would likely be within the salinity tolerance range for chinook salmon.

Installation of new exterior drainage gates would occur under the RGP and biological opinions, and thus should not affect any of the three runs of salmon. The NMFS biological opinion provides conditions to protect winter-run salmon. For example, all construction associated with replacing culverts or other water control structures must occur between 15 June and 30 September. USACE RGP R20066E98 required SRCD to develop and implement a diversion screening program. So far, SRCD has installed 13 screens under this program. Screens are designed to comply with USFWS delta smelt approach velocities, which are well below that required for salmon. To protect sensitive fish species at unscreened diversions, NMFS and USFWS have imposed restrictions that specify when landowners may divert water from sloughs.

Portable Pumps Program

The effect of the portable pumps operation to channel water salinity is expected to be minimal. Suisun Marsh channels are constantly cir-

culating through the ebb and flood tides. Drainage water from managed wetlands is typically more saline than channel water, which could result in a temporary localized salinity increase at the discharge site. The volume of water in the channels would soon dilute the more saline discharge water. Both juvenile and adult chinook salmon can tolerate salinity levels between 0 to 32 ppt, thus they would not be adversely affected by such a temporary influx of high salinity water. Further, because operation of these pumps would not change the volume of water discharged, no major changes in species distribution or abundance would be expected as a result of operating these portable pumps.

The portable pumps with fish screens would be used for diversions primarily during the late summer and fall for initial filling and during winter and spring for wetland habitat management. Pump operation would not increase the volume of water diverted and may actually protect aquatic resources. This may benefit chinook salmon as it would decrease losses due to fish entrainment. The pumps would be located throughout the managed wetlands, where such operation would be most effective.

Since fish screens are not one-hundred percent effective, some larval and juvenile fish could be diverted onto the interior ponded areas of the managed wetlands. As the pumps would be used in late summer, fall, winter and spring, juvenile winter-run, spring-run, and fall-run could be adversely affected by use of the pumps. However, the use of the portable pumps with fish screens would decrease diversions through existing unscreened structures.

Although these screened pump diversions may affect larval and juvenile fish, there may be a net benefit to other life stages of resident and migratory fish that are not protected from entrainment by the unscreened diversions currently servicing these managed wetlands. Ultimately, the use of portable diversion pumps with fish screens may benefit chinook salmon in the marsh as it would reduce fish entrainment.

Critical Habitat

In 1993, NMFS designated critical habitat for the endangered winter-run chinook from Keswick Dam (Sacramento river mile 302) to the Golden Gate Bridge (58 FR 33212). A petition to designate fall-run habitat as critical has been filed.

There is no petition for critical habitat for spring-run chinook salmon.

Existing Environment and Cumulative Effects

Current and ongoing anthropogenic negative effects to the three runs of chinook salmon and their habitat in the Suisun Marsh include the following.

- Blocking or delay of chinook salmon migration due to the presence and operation of the SMSCG.
- Entrainment of juvenile salmon into the managed wetlands at unscreened diversion culverts during water diversions.
- Habitat degradation resulting from decreases in flows due to water diversions.
- Poor water quality, due to the presence of toxics and pesticides in the water supply. Temporary, intermittent water quality problems can arise from the draining of acidic or anoxic water from the managed wetlands in to the marsh sloughs.

During fall 1998, a DFG-DWR study was initiated to determine whether a modification to the SMSCG flashboards would enable salmonids to migrate past the SMSCG without delay or blockage. Results from the first year of this study are not yet available.

SRCD must comply with requirements specified in RGP R20066E98 that decreases the potential for entrainment.

Conclusion and Determination

Probably the most significant adverse effects to chinook salmon in the marsh are the delay of migration due to the presence of the SMSCG and entrainment into the managed wetlands. Actions currently being taken (in other words, flashboard modification and monitoring) and most actions specified in Amendment Three (for example, installation of fish screens, monitoring of filling and draining by a water manager) will decrease the adverse effects of these preexisting problems.

In general, Amendment Three actions would either benefit chinook salmon (for example, improvement of flows, installation of fish screens, and so on) or have no effect on these fish (for example, converting S-35 and S-97 to monitoring stations). The only Amendment Three action that would potentially have an adverse effect on chinook salmon is the September SMSCG operation. However, as stated above, flashboard modification and monitoring is addressing this issue. Modifications to the flashboards will be pursued until chinook salmon migration is not significantly affected by presence of the SMSCG operations.

Central Valley Steelhead, *Oncorhynchus mykiss*

Status

Central Valley steelhead (*Oncorhynchus mykiss*) is federally listed as threatened. No critical habitat has been designated for this species in the project area.

Distribution

The following is quoted from the Federal Register 1996, Volume 61, Number 155.

> Central Valley steelhead Evolutionarily Sensitive Unit [ESU] occupies the Sacramento and San Joaquin Rivers and their tributaries. In the San Joaquin Basin, however, the best available information suggests that the current range of steelhead has been limited to the Stanislaus, Tuolumne, and Merced rivers (tributaries), and the mainstem San Joaquin River to its confluence with the Merced River by human alteration of formerly available habitat. The Sacramento and San Joaquin rivers offer the only migration route to the drainages of the Sierra Nevada and southern Cascade mountain ranges for anadromous fish. The distance from the Pacific Ocean to spawning streams can exceed 300 kin, providing unique potential for reproductive isolation among steelhead. The Central Valley is much drier than the coastal regions to the west, receiving on average only 10 to 50 cm of rainfall annually... Steelhead within this ESU have the longest freshwater migration of any population of winter steelhead. There is essentially one continuous run of steelhead in the upper Sacramento River. River entry ranges from July through May, with peaks in September and February. Spawning begins in late December and can extend into April (McEwan and Jackson 1996).

Steelhead ranged throughout the tributaries and headwaters of the Sacramento and San Joaquin rivers prior to dam construction, water development, and watershed perturbations of the 19th and 20th centuries. Present steelhead distribution in the Central valley drainages has been greatly reduced (McEwan and Jackson 1996), particularly in the San Joaquin basin ... With regard to the present distribution of steelhead, there is also only limited information. McEwan and Jackson (1996) reported that a small, remnant run of steelhead persists in the Stanislaus River, that steelhead were observed in the Tuolumne River in 1983, and that a few large rainbow trout that appear to be steelhead enter the Merced River Hatchery annually.

Historical abundance estimates are available for some stocks within this [the Central Valley] ESU, but no overall estimates are available prior to 1961, when Hallock and others (1961) estimated a total run size of 40,000 steelhead in the Sacramento River, including San Francisco Bay. In the mid-1960s, DFG (1965) estimated steelhead spawning populations for the rivers in this ESU, totaling almost 27,000 fish. Limited data exist on recent abundance for this ESU. The present total run size for this ESU based on dam counts, hatchery returns, and past spawning surveys is probably less than 10,000 fish. Both natural and hatchery runs have declined since the 1960s.

NMFS concludes that the Central Valley steelhead ESU is presently in danger of extinction. Steelhead have already been extirpated from most of their historical range in this ESU. Habitat concerns in this ESU focus on the widespread degradation,

> destruction, and blockage of freshwater habitats within the region, and the potential results of continual habitat destruction and water allocation problems.

Habitat

The following is quoted from Wang (1986).

> Spawning habitats range from large rivers to small creeks . . .Newly hatched larvae initially stay in the crevices of the nesting area until their yolk sac is absorbed (about two weeks) and then move into adjacent shallow and quiet pools located below riffles . . . Juvenile steelhead remain in freshwater streams from one to three years before entering the ocean (Moyle 1976)…In this study, many juvenile steelhead were observed in inshore, slough, and open waters of the estuary, in rivers, and even in some of the intermittent stream.

General Ecology

The following is quoted from the Federal Register 1996, Volume 61, Number 155.

> Steelhead may exhibit anadromy (meaning that they migrate as juveniles from fresh water to the ocean, and then return to spawn in fresh water) or freshwater residency (meaning that they reside their entire life in fresh water). Resident forms are usually referred to as "rainbow" or "redband" trout, while anadromous life forms are termed "steelhead." Few detailed studies have been conducted regarding the relationship between resident and anadromous *O. mykiss* and, as a result, the relationship between these two life forms is poorly understood.
>
> Steelhead typically migrate to marine waters after spending two years in fresh water. They then reside in marine waters for typically two or three years prior to returning to their natal stream to spawn at four or five years of age. Unlike Pacific salmon, steelhead are iteroparous, meaning that they are capable of spawning more than once before they die. However, it is rare for steelhead to spawn more than twice before dying; most that do so are females. Steelhead adults typically spawn between December and June (Bell 1990). Depending on water temperature, steelhead eggs may incubate in "redds" (nesting gravels) for 1.5 to 4 months before hatching as "alevins" (a larval life stage dependent on food stored in a yolk sac). Following yolk sac absorption, alevins emerge from the gravel as young juveniles or "fry" and begin actively feeding. Juveniles rear in fresh water from one to four years, then migrate to the ocean as "smolts."
>
> Biologically, steelhead can be divided into two reproductive ecotypes, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration. These two ecotypes are termed "stream-maturing" and "ocean-maturing." Stream-maturing steelhead enter fresh water in a sexually immature condition and require several months to mature and spawn. Ocean-maturing steelhead enter fresh water with well-developed gonads and spawn shortly after river entry. These two reproductive ecotypes are more commonly referred to by their season of freshwater entry (for example, summer and winter steelhead).

Occurrence in the Project Area

Central Valley steelhead have been captured intermittently in Suisun Marsh by the UC Davis Fisheries Monitoring Program (Matern and others 1997). In 1982, two steelhead were captured, while only one steelhead was caught

in 1985, 1988, 1996, and 1997. The UC Davis study has not reported any other catches of steelhead in the Suisun Marsh.

Project Impacts

The following Amendment Three actions will have no effect on Central Valley steelhead because they will occur exclusively in the managed wetlands or use structures that are equipped with fish screens.

- Managed Wetland Improvement Fund.
- Drought Response Fund.
- Roaring River Distribution System turnout repairs.
- Updating management plans.

Actions that could potentially affect Central Valley steelhead are described below, including several actions which will not affect these fish, but for which explanation is helpful.

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

The potential effects to special status species were addressed in the Environmental Report (Appendix 1) to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 1995). SWRCB concluded that the standards should preserve a salinity gradient within the unmanaged tidal marshes of the estuary, including the Suisun Marsh. The proposed increases in freshwater outflow are within the historical ranges of salinities and are not expected to adversely affect Central Valley steelhead.

The proposed Amendment Three channel salinity standards should not affect the natural (east-west and north-south) salinity gradient in the marsh. The salinity standards are upper limits, as are those required by SWRCB permit conditions in Order WR 98-9. These standards do not establish lower salinity limits. Except in very wet years, the natural salinity gradient would be higher in the western marsh as expected under the natural gradient. In addition, the original SMPA and water right permit standards do not interfere with the natural gradient because they provide for defined “deficiency periods” with appropriate relaxation of standards. These standards allow for increased salinity in the western marsh during drier years as would occur under a natural salinity gradient. These salinity standards would not adversely affect Central Valley Steelhead.

Converting S-35 and S-97 to Monitoring Stations

By converting S-35 and S-97 to monitoring stations, channel water salinity in the western marsh would, at times, be higher than Order WR 98-9 standards. This would not adversely affect adult Central Valley steel-head. Juveniles generally rear in fresh water from one to four years, thus, they may be affected if salinity levels rise considerably. However, steelhead have rarely been observed in the marsh. It is unlikely that the marsh is an important rearing area for juvenile steelhead.

Establishing Criteria for September SMSCG Operations

This proposal could affect steelhead in Montezuma Slough, if they are migrating through the marsh in September. Migration could be blocked and or delayed by gate operation. See the previous discussion on the effects of SMSCG operations on adult chinook salmon.

Adverse effects on Central Valley steelhead may be avoided by mitigation measures, such as modifications to flashboards that would enable steelhead to pass unimpeded. If such mitigation measures are pursued, this action would not likely have adverse effects on Central Valley steelhead.

Morrow Island Distribution System Fish Screens

This action may benefit Central Valley steelhead and other fish in the marsh. Placing a fish screen on the intake to the Morrow Island Distribution System will decrease the number of fish diverted into the system and entrained by the intakes, thus preventing mortality due to entrainment.

Lower Joice Island Unit Fish Screen

This action may benefit Central Valley steelhead and other fish in the marsh. Placing fish screens on the Lower Joice Island Unit will decrease the number of fish diverted into the system and entrained by the intakes, thus preventing mortality due to entrainment.

Water Manager Program

This action could benefit Central Valley steelhead. The water manager is responsible for monitoring the flood and drain periods to ensure that the properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS. This will prevent unnecessary diversions from the sloughs and bays and help protect resident and anadromous fish such as delta smelt, splittail, steelhead, and chinook salmon. The program manager would monitor the operation of fish screen facilities on private property and perform routine maintenance to ensure that screen operation is in compliance with design criteria for the facility. By decreasing the possibility of entrainment, this action may benefit steelhead.

Joint-use Facilities Program

Circulation and drainage ditch maintenance would occur inside the managed wetlands, so there would be no effects on Central Valley steelhead.

Increased turbidity due to installment of exterior drainage gates could affect steelhead. However, to avoid negative effects, new exterior drainage gates would be installed within one low tide, without excavation or in-water work. Thus, if these requirements are followed, this work will not adversely affect steelhead.

New exterior drainage gates may incrementally increase the amount of drainage water entering the tidal sloughs. Changes in salinity concentration might occur if several land areas drain into a small slough simultaneously. Such effects should be minimal, because the resulting salinity would likely be within the salinity tolerance range for steelhead.

Installation of new exterior drainage gates would occur under the RGP and biological opinions and, thus, would not adversely affect Central Valley steelhead. The NMFS biological opinion provides conditions to protect winter-run salmon, which would also be protective of steelhead. For example, all construction associated with replacing culverts or other water control structures must occur between 15 June and 30 September.

USACE RGP R20066E98 required SRCD to develop and implement a diversion screening program. So far, SRCD has installed 13 screens under this program. Screens are designed to comply with USFWS delta smelt approach velocities, which are well below required approach velocities for salmon and steelhead. To protect sensitive fish species at unscreened diversions, NMFS and USFWS have imposed restrictions that specify when landowners may divert water from sloughs.

Portable Pumps Program

Portable pumps operation is expected to minimally affect channel water salinity. Suisun Marsh channels are constantly circulating through the ebb and flood tides. Drainage water from managed wetlands is typically more saline than channel water and could

result in a temporary localized salinity increase at the discharge site. The volume of water in the channels would soon dilute the more saline discharge water. Adult steelhead can tolerate a wide range of salinity, thus they would not be adversely affected by such a temporary influx of high salinity water. Juveniles could potentially be affected by an increase in salinity. However, steelhead have rarely been observed in the marsh. It is unlikely that the marsh is an important rearing area for juvenile steelhead.

Because operation of these pumps would not change the volume of water discharged, no major changes in species distribution or abundance would be expected as a result of operating these portable pumps.

The portable pumps with fish screens would primarily be used for diversions during the late summer and fall for initial filling, and during winter and spring for wetland habitat management. Pump operation would not increase the volume of water diverted and may actually protect aquatic resources. This may benefit Central Valley steelhead as it would decrease losses due to entrainment. The pumps would be located throughout the managed wetlands, where such operation would be most effective.

Since fish screens are not one-hundred percent effective, some larval and juvenile fish could be diverted onto the interior ponded areas of the managed wetlands. Thus, juvenile steelhead could be adversely affected this way. However, steelhead have rarely been observed in the marsh (see above). It is unlikely that the marsh is an important rearing area for juvenile steelhead. Further, the use of the portable pumps with fish screens would decrease diversions through existing unscreened structures. Although these screened pump diversions may affect larval and juvenile fish, there may be a net benefit to other life stages of resident and migratory fish that are not protected from entrainment by the unscreened diversions currently servicing these managed wetlands.

Critical Habitat

There is no designated critical habitat for Central Valley steelhead in the project area.

Existing Environment and Cumulative Effects

Current and ongoing anthropogenic negative effects to Central Valley steelhead in the Suisun Marsh include the following.

- Blocking or delay of steelhead migration due to the presence and operation of the SMSCG.
- Entrainment of juvenile salmon into the managed wetlands at unscreened diversion culverts during water diversions.
- Habitat degradation resulting from decreases in flows due to water diversions.
- Poor water quality, due to the presence of toxics and pesticides in the water supply. Temporary, intermittent water quality problems can arise from the draining of acidic or anoxic water from the managed wetlands into the marsh sloughs.

During fall 1998, a joint (DFG and DWR) study was initiated to determine whether a modification to the SMSCG flashboards would enable salmonids to migrate past the SMSCG without delay or blockage. Results from the first year of this study are not yet available.

SRCD must comply with requirements specified in RGP R20066E98 that decrease the potential for entrainment.

Conclusion and Determination

As with chinook salmon, probably the most significant adverse effects to Central Valley steelhead are entrainment into the managed wetlands and the potential delay of migration due to the presence of the SMSCG. Actions currently being taken (for example, flashboard modification and monitoring) and most actions specified in Amendment Three (for example, installation of fish screens and monitoring of filling and draining by a water manager) will decrease the adverse effect of these preexisting problems.

In general, Amendment Three actions would either benefit Central Valley steelhead (for example, improvement of flows, installation of fish screens, and so on) or have no effect (for example, converting S-35 and S-97 to monitoring stations). The only Amendment Three action that would potentially have an adverse effect are September SMSCG operations. Since steelhead are rarely observed in the marsh, September SMSCG operations may have little or no effect on this species. Further, as stated above, flashboard modification and monitoring is addressing this issue. Modifications to the flashboards will be pursued until salmonid migration is not significantly affected by SMSCG operations.

Based on these findings, it appears that Amendment Three actions would not have a significant adverse effect on Central Valley steelhead. Certain actions under Amendment Three may actually provide some benefit to this species.

Delta Smelt, *Hypomesus transpacificus*

Status

Delta smelt (*Hypomesus transpacificus*) was listed as threatened by both DFG and USFWS in 1993. Critical habitat was designated for the delta smelt in 1995. Critical habitat includes the following areas: Suisun Bay (including the contiguous Grizzly and Honker bays); the length of Goodyear, Suisun, Cutoff, First Mallard, and Montezuma sloughs; and the existing continuous waters within the Sacramento-San Joaquin Delta.

Distribution

This schooling species inhabits open surface and shoal waters of main river channels and Suisun Bay (DWR 1992; SFEP 1992a). Juvenile and adult delta smelt commonly occur in the surface and shoal waters of the lower reaches of the Sacramento River below Mossdale, through the delta, and into Suisun Bay (Moyle 1976; Moyle and others 1992). Their normal downstream limit appears to be western Suisun Bay, although during periods of high outflow, they can be washed into San Pablo and San Francisco bays, but they do not establish permanent populations there (SFEP 1992a).

Habitat

The following is quoted from the Draft Species Narratives for Fish and Macroinvertebrates (Goals Project 1997).

> Spawning habitat has been as widely dispersed as the Napa River to Stockton in 1996. The predominate feature appears to be shallow, freshwater conditions with some sort of solid substrate for the attachment of eggs. Spawning has been reported to occur at about 45 to 59 °F (7 to 15 °C) in tidally influenced rivers and sloughs including dead-end sloughs and shallow edge waters of the upper delta.

Rearing and prespawning delta smelt generally inhabit a salinity range of less than two ppt (parts per thousand), although they have been collected at salinities as high as 10 to 14 ppt (DFG 1992). Analysis of the salinity preferences using midwater trawl data indicate that delta smelt distribution peaks upstream of the entrapment zone (Obrebski 1993). It should be noted, however, that the distribution of delta smelt is fairly broad, particularly in years when abundance levels are high (DWR and USBR 1993a). Evidence from the 1993 year-class also demonstrates that salt field position does not necessarily regulate delta smelt distribution in all years. In late 1993 and early 1994, delta smelt were found in Suisun Bay region despite the fact that "X2" was located upstream. Samples collected in this area demonstrated that high levels of copepod *Eurytemora* were present, suggesting that food availability may also influence smelt distribution (DWR and USBR 1994).

Although these results show that the delta smelt is not an entrapment zone specialist, there is evidence that their abundance is correlated with X2. Herbold (1994) found a significant relationship between the number of days X2 was in Suisun Bay during February through June versus midwater trawl abundance. Furthermore, when the entrapment zone is in Suisun Bay and both deep and shallow water exists, delta smelt are caught most frequently in shallow water (Moyle and others 1992).

> Results from UC Davis provide an indication of environmental tolerances of delta smelt (Cech and Swanson 1993). The study found that although delta smelt tolerate a wide range of water temperatures (8 to >25 °C), warmer temperatures apparently restrict their distribution more than colder temperatures.

General Ecology

The following is quoted from Moyle and others (1992).

> The delta smelt (*Hypomesus transpacificus*) is a small, short-lived native fish that is found only in the bay-delta estuary. Delta smelt usually inhabit the upper portion of the water column and at salinities ranging from 0 to 10 ppt (DFG 1992d). Overall, delta smelt concentrate near or immediately upstream of the entrapment zone. The delta smelt has low fecundity and is primarily an annual species, although a few individuals may survive a second year (SFEP 1992a). The location and season of delta smelt spawning vary from year to year. Spawning, which occurs in shallow, fresh, or slightly brackish water in or above the entrapment zone (DFG 1992d; USFWS 1994b), has been known to occur at various sites within the delta, including the lower Sacramento and San Joaquin rivers and Georgiana Slough, and in sloughs of the Suisun Marsh (USFWS 1994b). It appears that few delta smelt spawn in the southern delta. Based on egg and larval trawls over the last few years, it appears that, at least in low-flow years, a significant portion of delta smelt spawning now takes place in the northern and western delta (DWR and USBR 1994).

Spawning may occur from late winter (December) to early summer (July). In 1989 and 1990, peak spawning occurred in late-April and early-May (USFWS 1994b). The adhesive eggs descend through the water column and likely attach to submerged substrates such as tree roots, vegetation, and gravel (DFG 1992c). After hatching, the planktonic larvae are transported or gradually migrate downstream where they feed on zooplankton (USFWS 1994b).

The following is quoted from the Draft Species Narratives for Fish and Macroinvertebrates (Goals Project 1997).

> Seven surveys, although not specifically designed to gather data on delta smelt populations in the estuary, have charted the abundance of delta smelt. The summer townet survey, which began in 1959 and was primarily designed to measure striped bass abundance, is considered one of the best measures of delta smelt abundance because it covers much of the species' habitat and represents the longest historical record. Although the abundance indices vary considerably, they generally remained low between 1983 and 1993. In recent years moderately wet conditions have produced relatively high abundances in the summer townet survey. The reduced population levels during the 1980s appear to have been consistent throughout the delta and Suisun Bay, but declines may have occurred as early as the mid-1920s in the eastern and southern portions of the delta (DWR and USBR 1994).
>
> The midwater trawl survey provides one of the best indexes of smelt abundance because it covers most of the range of delta smelt (USBR and DWR 1994). From 1967 through 1975, fall catches were generally greater than ten smelt per trawl per month (in six of eight years); from 1976 through 1989, catches were generally less than ten smelt per trawl per month (in 13 of 14 years). Since 1986, catches have averaged

considerably less than one smelt per trawl per month. The frequency of occurrences of delta smelt in the trawls has also declined. Prior to 1983, delta smelt were found in 30% or more of the fall trawl catches. From 1983 to 1985, they occurred in less than 30% of the catches, and since 1986, they have been caught in less than 10% of the trawls (Herbold and others 1992a). In 1993, the midwater trawl index was the sixth highest of the 25 years of record. In 1994, the index dropped to a 28 year low, but it rebounded again in 1995. Unlike the summer townet survey indices, the mean catches of delta smelt have not declined in the midwater trawl survey. The smelt population is more dispersed in the summer than in the fall. The summer populations have decreased in average densities while the fall populations have decreased numbers of schools (DFG 1992d). Data from the Bay Study and the Suisun Marsh Study show sharp declines in delta smelt at about the same time. The exact timing of the decline is different in most of the sampling programs, but falls between 1982 and 1985 (Herbold and others 1992a).

No single factor appears to be the sole cause of the delta smelt decline; however declines have been attributed primarily to restricted habitat and increased losses though entrainment by delta diversions (DWR 1992a; Herbold and others 1992a; USFWS 1994b). Reduced water flow may intensify entrainment at pumping facilities, as well as reduce the quantity and quality of nursery habitat. Outflow also controls the location of the entrapment zone, an important part of the habitat of delta smelt. A weak, positive correlation exists between fall abundance of delta smelt and the number of days during the spring that the entrapment zone remained in Suisun Bay (Herbold 1994). The number of days when the entrapment zone has been in Suisun Bay from February through June is one of the only two parameters found so far described that predicts delta smelt abundance (Herbold 1994). Reduced suitable habitat and increased entrainment occurs when the entrapment zone moves out of the shallows of Suisun Bay and into the channels of the lower Sacramento and San Joaquin rivers as a result of low delta outflow. The movement of the entrapment zone to the river channels not only decreases the amount of area that can be occupied by smelt, but decreases food supply (Herbold and others 1992a). Their location in this part of the estuary makes delta smelt vulnerable to entrainment by the pumps of the SWP and CVP, as well as local agricultural diversions (DWR 1992a; NHI 1992a; Herbold and others 1992a). Diversions in the northern and central delta, where smelt are most abundant, are likely the greatest source of entrainment (USFWS 1994b). Larvae and juveniles appear to be particularly vulnerable to pumping because screens are not effective for these life stages (DWR and USBR 1994). Whether entrainment, as estimated by salvage, affects abundance remains to be demonstrated statistically. However, the relative effects of entrainment are higher in dry years, when the abundance of delta smelt is typically lowest and the distribution of the species shifts closer to the pumps in the interior delta. Water diversions such as the Contra Costa Canal, PG&E's power plants, and in-delta agricultural diversions, potentially entrain delta smelt in numbers comparable to or greater than at the CVP and SWP pumps. However, initial results from Interagency Ecological Program studies have found few delta smelt in agricultural diversions.

Although the effects of the recent high diversions of fresh water, coupled with drought conditions since 1987, are the

most likely causes of the decline in the delta smelt population, other contributing factors may include the following: the presence of toxic compounds in the water, competition and predation, food supply, disease, very high outflows, and low spawning stock.

Occurrence in the Project Area

Data from the UC Davis Fisheries Monitoring Program indicate that delta smelt may be found in Suisun Marsh throughout the year. Results from the 1995 larval sampling indicate that delta smelt do use the marsh for spawning and rearing. In 1994, delta smelt larvae were found primarily in Nurse and Suisun sloughs (Matern and others 1995). In 1995 and 1996 delta smelt larvae were found in all five of the sloughs sampled (Cordelia, Denverton, Nurse, Spring Branch, and Suisun), with the highest numbers occurring in Nurse Slough. During these years, larval fish were generally found March through June. Spawning also occurs in shallow fresh waters of Suisun Bay (Wang 1986).

Results from UC Davis fisheries monitoring indicate that delta smelt abundance in the marsh has been declining since at least the early 1980s (Matern and others 1996). Of the 513 delta smelt captured in otter trawls since 1979, only 49 have been collected since 1984. The annual mean catch per trawl of delta smelt peaked at 0.60 in the early 1980s, but has been 0.01 or less since 1984 (except in 1994, when it measured 0.07).

Project Impacts

The following Amendment Three actions will have no effect on delta smelt or delta smelt critical habitat because they would be conducted exclusively in the managed wetlands or use structures that are equipped with fish screens.

- Drought Response Fund.
- Roaring River Distribution System turnout repairs.
- Updating management plans.

Actions that could potentially affect delta smelt or critical habitat are described below, including several actions which will not affect these fish, but for which explanation is helpful.

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

The potential effects to special status species were addressed in the Environmental Report (Appendix 1) of the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 1995). SWRCB concluded that the standards should preserve a salinity gradient within the unmanaged tidal marshes of the estuary, including the Suisun Marsh. The proposed increases in freshwater outflow are within the historical salinity ranges and are not expected to adversely affect delta smelt.

The proposed Amendment Three channel salinity standards should not affect the natural (east-west and north-south) salinity gradient in the marsh. The salinity standards are upper limits, as are those required by SWRCB permit conditions in Orders WR 95-6 and 98-9. These standards do not establish lower salinity limits. Except in very wet years, the natural salinity gradient would be higher in the western marsh as expected under the natural gradient. In addition, the original SMPA and water right permit standards do not interfere with the natural gradient because they provide for defined “deficiency periods” with appropriate relaxation of standards. These standards allow for increased salinity in the western marsh during drier years as would occur under a natural salinity gradient. These standards would not adversely affect delta smelt or delta smelt critical habitat.

Converting S-35 and S-97 to Monitoring Stations

By converting S-35 and S-97 to monitoring stations, channel water salinity in the western marsh would, at times, be higher than Order WR 98-9 standards. This should not have an adverse effect on delta smelt nor would it adversely modify or destroy delta smelt critical habitat. Delta smelt are tolerant of a wide salinity range and have been collected from estuarine waters up to 14 ppt (22 mS/cm) salinity (Moyle and others 1992). Thus, they are unlikely to be adversely affected by possible increases in salinity due to this action.

Managed Wetlands Improvement Fund

This action provides funds for discharge facilities (discharge gates, culverts, flashboard risers and pumps), electricity and fuel for portable pumps, maintenance work including improvements to ditch systems, addition of spreader ditches, raising pond bottom sinks, and coring levees. The USFWS 1994 biological opinion regarding SRCD's periodic maintenance activities in Suisun Marsh (USFWS 1994b) states that “installation or modification of the culverts and water control structures has the potential to entrain all life stages of delta smelt thus prohibiting the free movement of delta smelt migrating to spawning or rearing grounds”. The biological opinion further states that “because no screening techniques have yet been developed to successfully screen larvae and juvenile delta smelt, it is likely that these entrained life stages would eventually be killed because free migration out of the diked duck clubs would be prohibited.” Thus, the activities associated with this action could adversely affect delta smelt. However, the biological opinion established terms and conditions for SRCD's incidental take permit, which minimizes the effect of incidental take on delta smelt. These terms and conditions include the following.

To minimize the effects of entrainment to delta smelt resulting from the installation of culverts and the flooding of diked areas, early draw-down shall be used by the Suisun Marsh Resource Conservation District if the previous water year was determined to be wet or above normal or the current water year is determined to be wet or above normal. In wet years, or in a year following a wet year, delta smelt tend to use the sloughs in the marsh for spawning and rearing. Thus, early draw-down will likely prevent entrainment of delta smelt during the flooding cycle.

This action will not adversely affect delta smelt if these terms and conditions are upheld. It would not have an adverse effect on delta smelt critical habitat.

Establishing Criteria for September SMSCG Operations

Neither SMSCG operations nor September SMSCG operations would have an adverse effect on delta smelt or delta smelt critical habitat. Delta smelt have a wide salinity tolerance range (0 to 14 ppt). Thus, changes in salinity due to SMSCG operations are not likely to affect this species or its habitat.

Morrow Island Distribution Fish Screens

This action may benefit delta smelt. Placing a fish screen on the intake to the Morrow Island Distribution System will decrease the number of fish diverted into the system and entrained by the intakes, thus decreasing the amount of mortality that occurs as a result of entrainment. While “no screening techniques have yet been developed to successfully screen larvae and juvenile delta smelt” (USFWS 1994b), the presence of screens will reduce entrainment substantially.

There are no potential effects to delta smelt critical habitat under this action.

Lower Joice Island Unit Fish Screen

This action may benefit delta smelt. Placing a fish screen on the Lower Joice Island Unit will decrease the number of fish diverted into the system and entrained by the intakes, thus decreasing the amount of mortality that occurs as a result of entrainment. While "no screening techniques have yet been developed to successfully screen larvae and juvenile delta smelt" (USFWS 1994b), the presence of screens will reduce entrainment substantially. There are no potential effects to delta smelt critical habitat under this action.

Water Manager Program

This action may benefit delta smelt. The USFWS 1994 biological opinion states that water diversions can have an adverse effect on delta smelt and delta smelt critical habitat by entraining adult or larval fish or by decreasing outflows incrementally. The water manager should monitor the flood and drain periods to ensure that the properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS. This monitoring will help prevent unnecessary diversions from the sloughs and bays and help protect delta smelt and delta smelt critical habitat. The water manager would monitor the operation of fish screen facilities on private property and perform routine maintenance to ensure that screen operation is in compliance with the design criteria for the facility. By decreasing unnecessary water diversions and the possibility of entrainment, this action may benefit this species and its habitat.

Joint-use Facilities Program

Circulation and drainage ditch maintenance, coring of common levees, and excavation of new circulation ditches are activities that occur exclusively inside the managed wetlands. Thus, these activities would not affect delta smelt or delta smelt critical habitat.

Installation of new culverts and water control structures will not adversely affect delta smelt or its critical habitat if the terms and conditions of USFWS's 1994 biological opinion are upheld (see the preceding discussion on the Managed Wetland Improvement Fund).

Installation of new exterior drainage gates would not adversely affect delta smelt or its critical habitat if the terms and conditions of the RGP and the biological opinions are upheld. The biological opinions provide conditions to avoid adverse effects and protect delta smelt and its critical habitat.

New exterior drainage gates may incrementally increase the amount of drainage water entering the tidal sloughs. Water quality changes could occur if several ownerships drain into a small slough simultaneously. This effect would be minimal because the resulting salinity would likely be within the existing range. In addition, effects of decreased water quality are temporary and, therefore, would not affect delta smelt critical habitat.

Portable Pumps Program

Operation of portable drainage pumps could have a temporary adverse effect on delta smelt and delta smelt critical habitat. Drainage water from managed wetlands is typically more saline than channel water, which could result in a temporary localized salinity increase at the discharge site. Rearing and prespawning delta smelt may be affected by this temporary increase in salinity because they tend to inhabit a salinity range of less than 2 ppt, although they have been collected at salinities as high as 14 ppt (Goals Project 1997). However, Suisun Marsh channels are constantly circulating through the ebb and flood tides and the volume of water in the channels would soon dilute the more saline discharge water.

Since operation of these pumps would not change the volume of water discharged, no

major changes in species distribution or abundance would be expected as a result of operating portable discharge pumps.

The effect on delta smelt and delta smelt critical habitat is expected to be relatively minor because it is temporary and intermittent.

The portable pumps with fish screens would be used for diversion primarily during the late summer and fall for initial filling and during winter and spring for wetland habitat management. Pump operation would not increase the volume of water diverted and may actually protect aquatic resources. This may benefit delta smelt because it would decrease losses due to entrainment. The pumps would be located throughout the managed wetlands, where such operation would be most effective.

Since fish screens are not one-hundred percent effective, some larval and juvenile fish could be diverted onto the interior ponded areas of the managed wetlands. Delta smelt larvae and juveniles could be adversely affected by use of the pumps. However, the use of the portable pumps with fish screens would decrease diversions through existing unscreened structures. Although these screened pump diversions may affect larval and juvenile fish, there may be a net benefit to other life stages of resident and migratory fish that are not protected from entrainment by the unscreened diversions currently servicing these managed wetlands.

This action may benefit delta smelt and have no effect on delta smelt critical habitat.

Critical Habitat

Critical habitat was designated for the delta smelt in 1995. Critical habitat includes the following areas: Suisun Bay (including the contiguous Grizzly and Honker bays); the length of Goodyear, Suisun, Cutoff, First Mallard, and Montezuma sloughs; and the existing continuous waters within the delta.

Existing Environment and Cumulative Effects

Current and ongoing anthropogenic negative effects to delta smelt and their habitat in the Suisun Marsh include the following.

- Entrainment of larval, juvenile, and adult delta smelt into the managed wetlands at unscreened diversion culverts during water diversions.
- Habitat degradation resulting from decreases in flows due to water diversions.
- Poor water quality, due to the presence of toxics and pesticides in the water supply. Temporary, intermittent water quality problems can arise from the draining of acidic or anoxic water from the managed wetland.

Conclusion and Determination

Probably the most significant adverse effect on delta smelt in the marsh is entrainment into managed wetlands during water diversion. Currently, SRCD must comply with requirements specified in RGP R20066E98 that decrease the potential for fish entrainment. Amendment Three would further decrease the likelihood of mortality due to entrainment by requiring the installation of additional fish screens on water diversion culverts and portable diversion pumps. Further, it includes the Water Manager Program, which would also benefit delta smelt by ensuring that properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS. Amendment Three could benefit prespawning and rearing

delta smelt during drought years by decreasing channel water salinity.

These findings indicate that Amendment Three would not adversely affect delta smelt and delta smelt critical habitat and may benefit this species.

Longfin Smelt, *Spirinchus thaleichthys*

Status

Longfin smelt (*Spirinchus thaleichthys*) is designated as a species of concern. No critical habitat or special protection has been granted to this species.

Distribution

The longfin smelt (*Spirinchus thaleichthys*) is a small, planktivorous fish that is found in several Pacific Coast estuaries from San Francisco Bay to Prince William Sound, Alaska. Until 1963, the population in San Francisco Bay was thought to be a distinct species. Within California, longfin smelt have been reported from Humboldt Bay and the mouth of the Eel River. However, data are infrequently collected from Humboldt Bay, and there are no recent records from the Eel River (SFEP 1992). In California, the largest longfin smelt reproductive population inhabits the bay-delta estuary (DFG 1992b). This four- to five-inch long (adult), pelagic, anadromous species spawns in the fresh waters of the Sacramento-San Joaquin Delta and lower rivers, rears throughout the estuary and matures in brackish and marine waters (SFEP 1997).

Habitat

Longfin smelt can tolerate salinities ranging from fresh water to sea water. Spawning occurs in fresh to brackish water over sandy-gravel substrates, rocks, or aquatic vegetation (Meng 1993). Optimal salinity for spawning is 0 to 0.5 ppt (CUWA 1994).

General Ecology

In the bay-delta estuary, the longfin smelt life cycle begins with spawning in the lower Sacramento and San Joaquin rivers, the delta, and freshwater portions of Suisun Bay (SFEP 1992a). Spawning may take place as early as November and extend into June, with the peak spawning period occurring from February to April (Meng 1993). The eggs are adhesive and, after hatching, the larvae are carried downstream by freshwater outflow to nursery areas in the lower delta and Suisun and San Pablo bays (SFEP 1992a). The principal nursery habitat for larvae occurs in the productive waters of Suisun and San Pablo bays. Adult longfin smelt are found mainly in Suisun, San Pablo, and San Francisco bays, although their distribution is shifted upstream in years of low outflow (Meng 1993).

Both longfin smelt and delta smelt spawn adhesive eggs in river channels of the eastern estuary and have larvae that are carried to nursery areas by freshwater outflow, however, the two species differ substantially. Consistently, a measurable portion of the longfin smelt population survives into a second year (SFEP 1992a). During the second year of life, they inhabit San Francisco Bay and, occasionally, the Gulf of the Farallones; thus, longfin smelt are often considered anadromous. Longfin smelt are also more broadly distributed throughout the estuary and are found at higher salinities than delta smelt (Sommer and others forthcoming). Because longfin smelt seldom occur in fresh water except to spawn, but are widely dispersed in brackish waters of the bay, it seems likely that their range formerly extended as far up into the delta as salt water intrudes. The easternmost catch of longfin smelt in the fall midwater trawl was at Medford Island in the central delta. They have been caught at all stations of the Bay Study. A pronounced difference between the two species in their region of overlap in Suisun Bay is by depth; longfin smelt are caught more abundantly at deep stations (10 in), whereas delta

smelt are more abundant at shallow stations (<3 in) (SFEP 1992a).

The following is quoted from SFEP (1997).

> There is a strong relationship between freshwater outflow during the spawning and larval periods and the subsequent abundance of longfin smelt. Outflow disperses buoyant larvae, increasing the likelihood that some will find food. By reducing salinities in Suisun and San Pablo bays, outflow may also provide habitat with few marine or freshwater competitors and predators (marine species often do not tolerate lower salinities and freshwater species have mechanisms to avoid being washed downstream).

The factor most strongly associated with the recent decline in the abundance of longfin smelt has been the increase in water diverted by the SWP and the CVP during the winter and spring months when the smelt are spawning (NHI 1992a, DWR 1992). The pumping changes the hydrology of the delta and increases the exposure of larval, juvenile, and adult longfin smelt to predation and entrainment (NHI 1992b). Salvage data indicate that longfin smelt have been more vulnerable to pumping operations since 1984. This increase in vulnerability may be due to the concentration of longfin smelt populations in the upper estuary, within the zone of influence of the pumps, as a result of reduced delta outflow. Also, decreases in outflow fail to disperse the larvae downstream to Suisun Bay nursery areas, away from the effects of delta pumping (Meng 1993).

Occurrence in the Project Area

Data from the UC Davis Suisun Marsh Fisheries Monitoring Program indicates that longfin smelt can occur in the marsh all year. Spawning occurs from November through June throughout the marsh and in Suisun Bay. Each year of the UC Davis larval fish survey, longfin smelt larval fish were captured in all five sloughs sampled (Suisun, Spring Branch, Nurse, Denverton, and Cordelia) (Matern and others 1995, 1996, 1997). However in 1996, the greatest portion of larval longfin smelt was captured in Cordelia Slough, which probably reflects that species' preference for more marine conditions (Matern and others 1996).

Longfin smelt abundance in the marsh declined sharply in the early 1980s and has remained low since then (Matern and others 1996). Annual mean catches between 1980 and 1985 were above 1.0 smelt per trawl, with a peak of 7.16 smelt per trawl in 1980. Since 1985, values have remained below 1.3; after 1990, values decreased to less than 0.35 smelt per trawl (DWR 1997a). Interestingly, the prolific 1990 spawn (1.29 smelt per trawl) did not alter the general decline in abundance, as low numbers of fry were caught in subsequent years.

Project Impacts

The following Amendment Three actions will have no effect on longfin smelt because they will be conducted exclusively in the managed wetlands or will use structures that are equipped with fish screens.

- Managed Wetland Improvement Fund.
- Drought Response Fund.
- Roaring River Distribution System turnout repairs.
- Updating management plans.

Actions that could potentially affect smelt are described below, including actions which will not affect the fish, but for which explanation is helpful.

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

The potential affects to special status species were addressed in the Environmental Report (Appendix 1) of the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 1995). SWRCB concluded that the standards should preserve a salinity gradient within the unmanaged tidal marshes of the estuary, including the Suisun Marsh. The proposed increases in freshwater outflow would maintain salinity within the historical ranges and are not expected to adversely affect longfin smelt abundance.

The proposed Amendment Three channel salinity standards should not affect the natural (east-west and north-south) salinity gradient in the marsh. The salinity standards are upper limits, as are those required by SWRCB permit conditions in Order WR 98-9. These standards do not establish lower salinity limits. Except in very wet years, the natural salinity gradient would be higher in the western marsh as expected under the natural gradient. In addition, the original SMPA and water right permit standards do not interfere with the natural gradient because they provide for defined "deficiency periods" with appropriate relaxation of standards. These standards allow for increased salinity in the western marsh during drier years as would occur under a natural salinity gradient. They would have no adverse effects on longfin smelt.

Converting S-35 and S-97 to Monitoring Stations

By converting S-35 and S-97 to monitoring stations, channel water salinity in the western marsh would, at times, be higher than the Order WR 98-9 standards. This should not have an adverse effect on larval, juvenile, or adult longfin smelt, which are tolerant of a wide range of salinities: the optimal salinity range for larval and juvenile longfin smelt is 1.1 to 18.5 ppt (Unger 1994). The higher salinities may possibly decrease the amount of good spawning habitat, however, it is unlikely that longfin smelt spawn in the western marsh, due to the higher salinity levels in that area. There-fore, this action is unlikely to have a significant effect on longfin smelt.

Establishing Criteria for September SMSCG Operations

This action is will not have any adverse effect on longfin smelt and may benefit the fish by improving spawning habitat. Any decreases in salinity due to early operation of the SMSCG are not likely to affect these fish, which have a wide salinity tolerance range. Early SMSCG operations may make the marsh fresher in November, thus improving spawning habitat for longfin smelt.

Morrow Island Distribution System Fish Screens

This action may benefit longfin smelt and other fish in the marsh. Placing a fish screen on the intake to the Morrow Island Distribution System will decrease the number of fish diverted into the system and entrained by the intakes, thus preventing mortality due to entrainment.

Lower Joice Island Unit Fish Screen

This action may benefit longfin smelt and other fish in the marsh. Placing fish screens on the Lower Joice Island Unit will decrease the number of fish diverted into the system and entrained by the intakes, thus preventing mortality due to entrainment.

Water Manager Program

This action could benefit longfin smelt. The water manager is responsible for monitoring the flood and drain periods to ensure that the properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS. This will

prevent unnecessary diversions from the sloughs and bays and help protect resident and anadromous fish such as longfin smelt, delta smelt, splittail, steelhead, and chinook salmon. The water manager would monitor the operation of fish screen facilities on private property and perform routine maintenance to ensure that screen operation is in compliance with design criteria for the facility. By decreasing the possibility of entrainment, this action may benefit longfin smelt.

Joint-use Facilities Program

Circulation and drainage ditch maintenance would occur inside the managed wetlands, so there would be no effects to longfin smelt.

Increased turbidity due to installment of exterior drainage gates could affect longfin smelt. However, to avoid adverse effects, new exterior drainage gates would be installed within one low tide, without excavation or in-water work. Thus, if these requirements are followed, this work will not adversely affect these fish.

New exterior drainage gates may incrementally increase the amount of drainage water entering the tidal sloughs. Changes in salinity concentration might occur if several land areas drain into a small slough simultaneously. Such effects should be minimal because the resulting salinity would likely be within the tolerance range for longfin smelt.

Installation of new exterior drainage gates would occur under the RGP and biological opinions. USACE RGP R20066E98 required SRCD to develop and implement a diversion screening program. So far, SRCD has installed 13 screens under this program. Screens are designed to comply with USFWS delta smelt approach velocities, which should make them protective of other sensitive fish species. To protect sensitive fish species at unscreened diversions, NMFS and USFWS have imposed restrictions that specify when landowners may divert water from sloughs.

Portable Pumps Program

Operation of portable drainage pumps could have a temporary effect on longfin smelt spawning. Drainage water from managed wetlands is typically more saline than channel water, which could result in a temporary localized salinity increase at the discharge site. Such discharges could prohibit longfin smelt from spawning in the vicinity. However, Suisun Marsh channels are constantly circulating through the ebb and flood tides and the volume of water in the channels would soon dilute the more saline discharge water. Juvenile and adult longfin smelt would not likely be affected by any temporary increases in salinity due to this action as they are tolerant of a wide range of salinities (CUWA 1994).

Since operation of these pumps would not change the volume of water discharged, no major changes in species distribution or abundance would be expected as a result of operating portable discharge pumps.

This effect is expected to be relatively minor.

The portable pumps with fish screens would be used for diversion primarily during the late summer and fall for initial filling, and during winter and spring for wetland habitat management. Pump operation would not increase the volume of water diverted and may actually protect aquatic resources. This may benefit longfin smelt because it would decrease losses due to entrainment. The pumps would be located throughout the managed wetlands, where such operation would be most effective.

Since fish screens are not one-hundred percent effective, some larval and juvenile fish could be diverted onto the interior ponded areas of the managed wetlands. Since the pumps would be used primarily in late summer and fall for

initial filling and during winter and spring for wetland habitat management, longfin smelt larvae and juveniles could be adversely affected. However, the use of the portable pumps with fish screens would decrease diversions through existing unscreened structures. Although these screened pump diversions may affect larval and juvenile fish, there may be a net benefit to other life stages of resident and migratory fish that are not protected from entrainment by the unscreened diversions currently servicing these managed wetlands.

This action may benefit longfin smelt.

Critical Habitat

There is no designated critical habitat for longfin smelt in the project area.

Existing Environment and Cumulative Impacts

Current and ongoing anthropogenic negative effects to longfin smelt and its habitat in Suisun Marsh include the following.

- Entrainment of larval and juvenile longfin smelt into the managed wetlands at unscreened diversion culverts during water diversions.
- Habitat degradations resulting from decreases in flows due to water diversions.
- Poor water quality, due to the presence of toxics and pesticides in the water supply. Temporary, intermittent water quality problems can arise form the draining of acidic or anoxic water form the managed wetlands into the marsh sloughs.

Conclusion and Determination

Probably the most significant adverse effect on longfin smelt in the marsh is entrainment into managed wetlands during water diversions. Currently, SRCD must comply with requirements specified in RGP R20066E98 that decrease the potential for fish entrainment. Amendment Three would further decrease the likelihood of mortality due to entrainment by requiring the installation of additional fish screens on water diversion culverts and portable diversion pumps. Further, it includes the Water Manager Program, which would also benefit longfin smelt by ensuring that properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS. Amendment Three could improve conditions for spawning longfin smelt in the marsh by decreasing channel water salinity during drought years.

These findings indicate that Amendment Three would not adversely affect longfin smelt in the Suisun Marsh and may actually provide benefits to this species.

Sacramento Splittail, *Pogonichthys macrolepidotus*

Status

Sacramento splittail (*Pogonichthys macrolepidotus*) was proposed threatened by the USFWS in January 1994. No final decision has been made regarding the listing of this fish.

Distribution

The Sacramento splittail (*Pogonichthys macrolepidotus*) is a large minnow endemic to the bay-delta estuary. Once found throughout low elevation lakes and rivers of the Central Valley from Redding to Fresno, this native species is now confined to the lower reaches of the Sacramento and San Joaquin rivers, the Sacramento-San Joaquin Delta, Suisun and Napa marshes, and tributaries of north San Pablo Bay (DFG 1994). Although the Sacramento splittail is considered a freshwater species, the adults and sub-adults have an unusually high tolerance for saline waters, up to 10 to 18 ppt (Meng 1993), for a member of the minnow family (DFG 1994). Therefore, the Sacramento splittail is often considered an estuarine species. When splittail were more abundant, they were commonly found in Suisun Bay and Suisun Marsh. The salt tolerance of splittail larvae is unknown (DFG 1992a).

Habitat

Inundated floodplains provide important spawning, rearing and foraging habitat for splittail. Spawning, which seems to be triggered by increasing water temperatures and day length, occurs over beds of submerged vegetation in slow-moving stretches of water, such as flooded terrestrial areas and dead-end sloughs. Adults spawn in the delta and its tributaries, Yolo and Sutter bypasses, Napa Marsh and Suisun Marsh. Hatched larvae remain in shallow, weedy areas until they move to deeper offshore habitat later in the summer. Young splittail may occur in shallow and open waters of the delta, Suisun Bay and San Pablo Bay, but they are particularly abundant in the northern and western delta (DFG 1992a, DWR 1992).

The downstream distribution (including Suisun Marsh) of splittail appears to be affected by salinity. Although splittail have been collected at salinities as high as 18 ppt and physiological studies show that splittail have critical salinity maxima of 20 to 29 ppt (Young and Cech 1996), abundance is highest in the 0 to 10 ppt salinity range (Sommer and others forthcoming). Hence, salinity may have limited the downstream distribution of splittail during the recent six-year drought. Splittail also tolerate a wide range (7 to 33 °C) of water temperatures in the laboratory, which fits well with thermal fluctuations associated with its habitat. Depending upon the acclimation temperature (range 12 to 20 °C), critical thermal maxima ranged from 22 to 23 °C (Young and Cech 1996). Sommer and others (forthcoming) suggest that temperature may have an affect on abundance in the San Joaquin River system.

General Ecology

The Sacramento splittail, which has a high reproductive capacity, can live five to seven years and generally reaches sexual maturity by its second year (Daniels and Moyle 1983; Meng and Moyle 1995; Sommer and others forthcoming). Spawning peaks during February through June, but may extend from January through July.

Splittail are benthic foragers that feed extensively on opossum shrimp (*Neomysis mercedis*) and opportunistically on earthworms,

clams, insect larvae, and other invertebrates (Caywood 1974; Herbold 1987). Splittail are preyed upon by striped bass and other predatory fish in the estuary. Food selection studies from Suisun Marsh suggest that splittail specifically select *Neomysis* as their main prey item in the estuary (Herbold 1987). Splittail did not switch to alternate and more prevalent food items, as was observed for other native resident species.

Abundance indices of the Sacramento splittail based on fall midwater trawl catches have varied over the years. The indices, based on sampled juvenile splittail, were relatively high in the late 1960s (for example, 66.3 in 1967) and then declined severely until 1977. After 1977, splittail abundances increased to a record high of 153.2 in 1983, after which the index declined to 3.6 in 1992. Likewise, the Bay Study indices for splittail were highly variable. Maximum abundances were attained in 1982, 1983, and 1986 (all wet years); but abundance indices declined during drought conditions in the late 1980s and early 1990s. There appears to be no consistent decline in adult abundance for most surveys. However, both the Suisun Marsh and Chipps Island surveys show significantly lower abundance in the early to mid-1980s (Sommer and others forthcoming). Wet year conditions in 1995 resulted in record or near-record indices for most surveys (Sommer and others forthcoming).

The Sacramento splittail, which was once widely distributed throughout the Central Valley, has declined in abundance because of loss or alteration of lowland habitats following dam construction, water diversion, and agricultural development (Meng and Moyle 1995). The Sacramento splittail has lost much of its original foraging and spawning habitats through losses of marshlands due to land reclamation activities.

Floodplain inundation appears to be a key factor responsible for strong year classes, based on both statistical and limited observational data (Sommer and others forthcoming). Higher flows increase inundation of floodplain areas such as the Yolo Bypass, which provides spawning, rearing and foraging habitat. The species has little or no stock recruitment relationship. This is best illustrated from data collected in 1995, when exceptionally large numbers of young splittail were produced by a stock that should have been depleted by drought conditions in seven of the previous eight years.

Attributes that help splittail respond rapidly to improved environmental conditions include a relatively long life span, high reproductive capacity and broad environmental tolerances (Sommer and others forthcoming). Additional factors that may affect population levels include habitat loss, recreational fishing, entrainment and toxic compounds.

The effects of introduced species (for example, planktonic copepods and the Asian clam, *Potamocorbula*) in reducing the splittail's favored prey, *Neomysis mercedis*, have also been named as possible factors in the decline of Sacramento splittail populations in the estuary (NHI 1992b).

Occurrence in the Project Area

The Suisun Marsh and Bay may be the most important habitats for splittail (Meng and Moyle 1995). Splittail are present in the marsh and bay all year. In 1995, large numbers of splittail larvae were taken in Nurse and Denverton sloughs, however, they were also taken in Cordelia, Spring Branch and Suisun sloughs.

Matern and others (1996) attribute the high abundance of splittail young-of-the-year (YOY) in Suisun Marsh in 1980, 1982 and

1986 to the high flow conditions of those years. Little recruitment occurred in the marsh since 1986: apparently adults outnumbered YOY in the catches for most of these years. In 1994, both adult and YOY were at an all time low, however, abundance was high in both 1995 and 1996. UC Davis researchers report that more adult splittail were caught in 1996 than in any year since 1987, while catches of YOY were higher in 1996 than any year since 1986 (Matern and others 1996). This is because splittail spawn in the spring and a given YOY cohort gets collected over a two year period. YOY were not as abundant in 1996 as they were in 1995. Matern and others (1996) suggest that this may be related to the difference in the timing of the rains of 1995 and 1996: in 1995, the heaviest outflow occurred in March, allowing spawning splittail to take advantage of the flooded vegetation, but in 1996 rains may have come too early to favor splittail spawning.

Sommer and others (forthcoming) note that splittail abundance has not rebounded to the same degree in Suisun Marsh as in other delta locations following recent wet years. They hypothesize that Suisun Marsh abundance may be strongly affected by shifts in the center of spawning activity. In other words, peak Suisun Marsh abundance during 1979 and 1980 may have been a result of localized spawning in marsh channels. In later years, the center of spawning activity appears to have shifted to the Sacramento and San Joaquin systems. If this hypothesis is correct, it may be difficult to differentiate between a real population decline in Suisun Marsh versus a change in the species' center of distribution.

Between 1980 and 1983 and in 1986, annual mean catch per trawl was greater than 2.09. In all other years the catch was between 0.93 to 0.07 catch per trawl (DWR 1997a). Annual abundance of adult splittail has ranged from 0.13 to 4.35 mean catch per trawl. Average catches at or above 1.50 occurred in 1980, 1981 and 1987. All other years produced annual mean catches at or below 0.68.

Project Impacts

The following Amendment Three actions will have no effect on splittail because they would be conducted exclusively in the managed wetlands or use structures that are equipped with fish screens.

- Managed Wetland Improvement Fund.
- Drought Response Fund.
- Roaring River Distribution System turnout repairs.
- Updating management plans.

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

The potential affects to special status species were addressed in the Environmental Report (Appendix 1) of the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 1995). SWRCB concluded that the standards should preserve a salinity gradient within the unmanaged tidal marshes of the estuary, including the Suisun Marsh. The proposed increases in freshwater outflow are within the historical salinity ranges and are not expected to adversely affect Sacramento splittail.

The proposed Amendment Three channel salinity standards should not affect the natural (east-west and north-south) salinity gradient in the marsh. The salinity standards are upper limits, as are those required by SWRCB permit conditions in Order WR 98-9. These standards do not establish lower salinity limits. Except in very wet years, the natural salinity gradient would be higher in the western marsh as expected under the natural gradient. In addi-

tion, the original SMPA and water right permit standards do not interfere with the natural gradient because they provide for defined "deficiency periods" with appropriate relaxation of standards. These standards allow for increased salinity in the western marsh during drier years as would occur under a natural salinity gradient. The standards would have no adverse effects on splittail.

Converting S-35 and S-97 to Monitoring Stations

By converting S-35 and S-97 to monitoring stations, channel water salinity in the western marsh would, at times, be higher than Order WR 98-9 standards. This may adversely affect Sacramento splittail, which, while highly tolerant of brackish water, also appear to maintain highest abundances when channel water salinity is between 0 to 10 ppt (Sommer and others forthcoming). However, these fish have been collected at salinities as high as 18 ppt and physiological studies show that split-tail have critical salinity maxima of 20 to 29 ppt (Young and Cech 1996). Thus, this action may result in lower abundances of splittail in the western marsh during dry and critical years.

Establishing Criteria for September SMSCG Operations

This action may benefit Sacramento splittail by lowering salinity in the marsh. While splittail are highly tolerant of brackish water, their abundances are highest between 0 to 10 ppt (Sommer and others forthcoming).

Morrow Island Distribution Fish Screens

This action may benefit Sacramento splittail and other fish. Placing a fish screen on the intake to the Morrow Island Distribution System will decrease the number of fish diverted into the system and entrained by the intakes, thus decreasing the amount of mortality that occurs as a result of entrainment. While "no screening techniques have yet been developed to successfully screen larvae and juvenile delta smelt" (USFWS 1994b), the presence of screens will reduce entrainment substantially.

Lower Joice Island Unit Fish Screen

This action may benefit Sacramento splittail. Placing a fish screen on the Lower Joice Island Unit will decreased the number of fish diverted into the system and entrained by the intakes, thus decreasing the amount of mortality that occurs as a result of entrainment.

Water Manager Program

This action may benefit Sacramento splittail. The USFWS 1994 biological opinion indicates that water diversions can have an adverse effect on certain fish species by entraining adult or larval fish or by decreasing outflows incrementally. The water manager is responsible for monitoring the flood and drain periods to ensure that the properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS. This monitoring will help prevent unnecessary diversions from the sloughs and bays and help protect Sacramento splittail. The water manager would monitor the operation of fish screen facilities on private property and perform routine maintenance to ensure that screen operation is in compliance with design criteria for the facility. By decreasing unnecessary water diversions and the possibility of entrainment, this action may benefit this species and its habitat.

Joint-use Facilities Program

Circulation and drainage ditch maintenance would occur inside the managed wetlands, so there would be no effects to Sacramento splittail.

Increased turbidity due to installment of exterior drainage gates could affect Sacramento splittail. However, to avoid negative effects, new exterior drainage gates would be installed

within one low tide, without excavation or in-water work. If these requirements are followed, this work will not adversely affect these fish.

New exterior drainage gates may incrementally increase the amount of drainage water entering the tidal sloughs. Changes in salinity concentration might occur if several land areas drain into a small slough simultaneously. Such effects should be minimal because the resulting salinity would likely be within the tolerance range for Sacramento splittail.

Installation of new exterior drainage gates would occur under the RGP and biological opinions. USACE RGP R20066E98 required SRCD to develop and implement a diversion screening program. So far, SRCD has installed 13 screens under this program. Screens are designed to comply with USFWS delta smelt approach velocities, which should also protect other sensitive fish species. To protect sensitive fish species at unscreened diversions, NMFS and USFWS have imposed restrictions that specify when landowners may divert water from sloughs.

Portable Pumps Program

Operation of portable drainage pumps could have a minor, temporary adverse effect on Sacramento splittail. Drainage water from managed wetlands is typically more saline than channel water, which could result in a temporary localized salinity increase at the discharge site. However, Suisun Marsh channels are constantly circulating through the ebb and flood tides and the volume of water in the channels would soon dilute the more saline discharge water.

Since operation of these pumps would not change the volume of water discharged, no major changes in species distribution or abundance would be expected as a result of operating portable discharge pumps.

The portable pumps with fish screens would be used for diversion primarily during the late summer and fall for initial filling, and during winter and spring for wetland habitat management. Pump operation would not increase the volume of water diverted and may actually protect aquatic resources. This may benefit Sacramento splittail as it would decrease losses due to entrainment. The pumps would be located throughout the managed wetlands, where such operation would be most effective.

Since fish screens are not one-hundred percent effective, some larval and juvenile fish could be diverted onto the interior ponded areas of the managed wetlands. As the pumps would be used primarily in late summer and fall for initial filling, and during winter and spring for wetland habitat management, splittail larvae and juveniles could be adversely affected by use of the pumps. However, the use of the portable pumps with fish screens would decrease diversions through existing unscreened structures. Although these screened pump diversions may affect larval and juvenile fish, there may be a net benefit to other life stages of resident and migratory fish that are not protected from entrainment by the unscreened diversions currently servicing these managed wetlands.

This action may benefit Sacramento splittail.

Critical Habitat

There is no designated critical habitat for Sacramento splittail in the project area.

Existing Environment and Cumulative Effects

Current and ongoing anthropogenic negative effects to splittail and their habitat in the Suisun Marsh include the following.

- Entrainment of larval, juvenile and adult splittail into the managed wet-

lands at unscreened diversion culverts during water diversions.

- Habitat degradation resulting from decreases in flows due to water diversions.

- Poor water quality, due to the presence of toxics and pesticides in the water supply. Temporary, intermittent water quality problems can arise from the draining of acidic or anoxic water from the managed wetlands into the marsh sloughs.

- Recreational fishing.

Conclusion and Determination

Probably the most significant adverse effect on splittail in the marsh is entrainment into managed wetlands during water diversion. Currently, SRCD must comply with requirements specified in RGP R20066E98 that decrease the potential for fish entrainment. Amendment Three would further decrease the likelihood of mortality due to entrainment by requiring the installation of additional fish screens on water diversion culverts and portable diversion pumps. Further, it includes the Water Manager Program, which would also benefit splittail by ensuring that properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS. Converting S-35 and S-97 to monitoring stations could possibly result in somewhat lower abundances of splittail in the western marsh during dry or critical years. However, it is unlikely that the salinities that occur would affect splittail, which have a wide salinity tolerance range.

These findings indicate that Amendment Three would not adversely affect splittail and may actually benefit this species.

Green Sturgeon, *Acipenser medirostris*

Status

Green sturgeon (*Acipenser medirostris*) is designated a federal species of special concern by the USFWS and a California species of special concern by the DFG.

Distribution

The following is quoted from Moyle and others (1995).

> In the ocean off North America, green sturgeon have been caught from the Bering Sea to Ensenada, Mexico, a range which includes the entire coast of California. They have been found in rivers from British Columbia south to the Sacramento River in California ... Green sturgeon are particularly abundant in the Columbia River estuary and individuals had been observed 225 km inland in the Columbia River (Wydoski and Whitney 1979); presently they are found almost exclusively in the lower 60 km and do not occur upstream of Bonneville Dam (ODFW 1991). There is no evidence of spawning in the Columbia River or other rivers in Washington ... In California, green sturgeon spawning has been confirmed in recent years only in the Sacramento River and the Klamath River, although spawning probably once occurred in the Eel River as well (Moyle and others 1994).

In California, green sturgeon have been collected in small numbers in marine waters from the Mexican border to the Oregon border. They have been noted in a number of rivers, but spawning populations are known only in the Sacramento and Klamath rivers (see below). The following distributional information on green sturgeon in California waters was compiled by Patrick Foley (TJCD).

The San Francisco Bay system, consisting of San Francisco Bay, San Pablo Bay, Suisun Bay and the Delta, is home to the southern-most reproducing population of green sturgeon. In fact, green sturgeon were originally described from San Francisco (Ayres 1854). White sturgeon are the most abundant sturgeon in this system; green sturgeon have always been comparatively uncommon (Ayres 1854; Jordan and Gil-bert 1883). Intermittent studies by the DFG between 1954 and 1991 have measured and identified 15,901 sturgeon of both species. Based on these data, a green sturgeon to white sturgeon ratio of 1:9 was derived for fish less than 101 cm FL and 1:76 for fish greater than 101 cm FL (Kohlhorst, personal communication, see “Notes”). If we assume that green sturgeon and white sturgeon are equally vulnerable to capture by various gear and that the DFG population estimates of white sturgeon (11,000 to 128,000 fish, depending on the year) are accurate (Kohlhorst and others 1991), then the number of green sturgeon in the estuary longer than 102 cm has ranged from 200 to 1,800 fish (Kohlhorst, personal communication, see “Notes”). These numbers should be regarded as very rough estimates because the above assumptions are shaky.

The numbers of juvenile green sturgeon are presumably even more variable than the number of adults since reproduction is presumably episodic (characteristic also of white sturgeon, Kohlhorst and others 1991). One indication of this is the numbers of green sturgeon salvaged at the SWP and CVP fish screens in the south delta, which are mainly juveniles. Between 1979 and 1991, 6,341 fish identified as green sturgeon were captured at the two facilities combined; 32,708 white sturgeon were identi-

fied in the same period. Annual numbers ranged from 45 (1991) to 1,476 (1983). Other high salvage years were 1982 (1,093) and 1985 (1,377). However, these data are not particularly reliable because of poor quality control of both count and species identification (Kohlhorst, personal communication, see "Notes"). In addition, juvenile sturgeon are probably more vulnerable to entrainment at low or inter-mediate outflows.

Habitat

The following is quoted from Moyle and others (1995).

> The habitat requirements of green sturgeon are poorly known, but spawning and larval ecology probably are similar to that of white sturgeon. However, the comparatively large egg size, thin chorionic layer on the egg, and other characteristics indicate that green sturgeon probably require colder, cleaner water for spawning than white sturgeon (Doroshov, personal communication, see "Notes"). In the Sacramento River, adult sturgeon are in the river, presumably spawning, when temperatures range between 8 to 14 °C. Preferred spawning substrate likely is large cobble, but can range from clean sand to bedrock. Eggs are broadcast-spawned and externally fertilized in relatively high water velocities and probably at depths >3 inches (Emmett and others 1991). The importance of water quality is uncertain, but silt is known to prevent the eggs from adhering to each other (C. Tracy, minutes to USFWS meeting on green sturgeon, Arcata, California, May 3, 1990).

General Ecology

The following is quoted from Moyle and others (1995).

The ecology and life history of green sturgeon have received comparatively little study evidently because of their generally low abundance in most estuaries and their low commercial and sport fishing value in the past. Adults are more marine than white sturgeon, spending limited time in estuaries or fresh water.

Green sturgeon migrate up the Klamath River between late February and late July. The spawning period is March through July, with a peak from mid-April to mid-June (Emmett and others 1991). Spawning times in the Sacramento River are probably similar, based on times when adult sturgeon have been caught there . . . Spawning takes place in deep, fast water ... Indirect evidence indicates that green sturgeon spawn both in the Sacramento River and the Feather River.

Female green sturgeon produce 60,000 to 140,000 eggs (Moyle 1976), which are about 3.8 mm in diameter (C. Tracy, minutes to USFWS meeting). Based on their presumed similarity to white sturgeon, green sturgeon eggs probably hatch around 196 hours (at 12.7 0C) after spawning, and the larvae should be 8 to 19 mm long; juveniles likely range in size from 2.0 to 150 cm (Emmett and others 1991). Juveniles migrate out to sea before two years of age, primarily during summer-fall (Emmett and others 1991). Length-frequency analyses of sturgeon caught in the Klamath Estuary by beach seine indicates that most green sturgeon leave the system at lengths of 30 to 60 cm, when they are one to four years old, although a majority apparently leave as yearlings (USFWS 1982). They apparently remain near estuaries at first, but can migrate considerable distances as they grow larger (Emmett and others 1991). Individuals tagged by DFG in San Pablo Bay (part of the San Francisco Bay system)

have been recaptured off Santa Cruz, California, in Winchester Bay on the southern Oregon coast, at the mouth of the Columbia River and in Gray's Harbor, Washington (Chadwick 1959; Miller 1972). Most tags for green sturgeon tagged-in the San Francisco Bay system have been returned from outside that estuary (D. Kohlhorst, minutes to USFWS meeting).

Juveniles and adults are benthic feeders, and may also take small fish. Juveniles in the Sacramento-San Joaquin Delta feed on opossum shrimp (*Neomysis mercedis*) and amphipods (*Corophium* spp.) (Radtke 1966). Adult sturgeon caught in Washington had been feeding mainly on sand lances (*Ammodyics hexapterus*) and callianassid shrimp (P. Foley, unpublished). In the Columbia River estuary, green sturgeon are known to feed on anchovies, and they perhaps also feed on clams (C. Tracy, minutes to USFWS meeting). Adults can reach sizes of 2.3 inches FL and 159 kg, but in San Francisco Bay most are probably less than 45 kg (Skinner 1962).

Occurrence in the Project Area

The Matern and others (1997a) report only one instance of a green sturgeon catch in Suisun Marsh during the entire period of record (1979 through 1997). In April 1996, one green sturgeon was captured during trawling in Suisun Slough. Wang (1986) indicates that Radke caught green sturgeon in Suisun Bay in the 1960s. It should not be surprising that green sturgeon are rarely caught in the marsh since adults tend to occur more frequently in marine environments than either brackish or fresh water. While the marsh may provide some habitat for these green sturgeon, it does not provide spawning habitat, as these fish spawn in deep, cold, clean, fast-moving waters (Moyle and others 1995).

Project Impact

The following Amendment Three actions will have no effect on green sturgeon because they occur exclusively in the managed wetlands or use structures that are equipped with fish screens.

- Managed Wetland Improvement Fund.
- Drought Response Fund.
- Roaring River Distribution System turnout repairs.
- Updating management plans.

Actions that could potentially affect green sturgeon are described below, including several actions which will not affect the fish, but for which explanation is helpful.

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

The potential affects to special status species were addressed in the Environmental Report (Appendix 1) of the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 1995). SWRCB concluded that the standards should preserve a salinity gradient within the unmanaged tidal marshes of the estuary, including the Suisun Marsh. The proposed increases in freshwater outflow are within the historical salinity ranges and are not expected to adversely affect green sturgeon.

The proposed Amendment Three channel salinity standards should not affect the natural (east-west and north-south) salinity gradient in the marsh. The salinity standards are upper limits, as are those required by SWRCB permit conditions in Order WR 98-9. These standards do not establish lower salinity limits. Except in very wet years, the natural salinity gradient would be higher in the western marsh as

expected under the natural gradient. In addition, the original SMPA and water right permit standards do not interfere with the natural gradient because they provide for defined "deficiency periods" with appropriate relaxation of standards. These standards allow for increased salinity in the western marsh during drier years as would occur under a natural salinity gradient. They would not adversely affect green sturgeon.

Converting S-35 and S-97 to Monitoring Stations

By converting S-35 and S-97 to monitoring stations, channel water salinity in the western marsh would, at times, be higher than Order WR 98-9 standards. This will not adversely effect these anadromous fish.

Establishing Criteria for September SMSCG Operations

Neither SMSCG operations nor September SMSCG operations would have an adverse effect on green sturgeon. Green sturgeon, which are anadromous, should not be affected by any decreases in salinity due to SMSCG operations. Further, green sturgeon do not appear to migrate through Montezuma Slough on their way upstream to spawning grounds: only one green sturgeon has been captured in Suisun Marsh between 1979 and 1997, and that was in Suisun Slough. Thus, it is highly unlikely that SMSCG operation has any effect on the upstream migration of these fish.

Morrow Island Distribution Fish Screens

This action may benefit green sturgeon and other fish. Placing a fish screen on the intake to the Morrow Island Distribution System will decreased the number of fish diverted into the system and entrained by the intakes, thus decreasing the amount of mortality that occurs as a result of entrainment.

Lower Joice Island Unit Fish Screen

This action may benefit green sturgeon and other fish. Placing a fish screen on the Lower Joice Island Unit will decreased the number of fish diverted into the system and entrained by the intakes, thus decreasing the amount of mortality that occurs as a result of entrainment. While no screening technique is one-hundred percent effective, the presence of screens will reduce entrainment substantially.

Water Manager Program

This action may benefit green sturgeon. The USFWS 1994 biological opinion indicates that water diversions can have an adverse effect on certain fish, by entraining adult or larval fish or by decreasing outflows incrementally. The water manager is responsible for monitoring the flood and drain periods to ensure that the properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS. This monitoring will help prevent unnecessary diversions from the sloughs and bays and help protect green sturgeon. The water manager would monitor the operation of fish screen facilities on private property and perform routine maintenance to ensure that screen operation is in compliance with design criteria for the facility. By decreasing unnecessary water diversions and the possibility of entrainment, this action may benefit this species.

Joint-use Facilities Program

Circulation and drainage ditch maintenance would occur inside the managed wetlands, so there would be no effects on green sturgeon.

Increased turbidity due to installment of exterior drainage gates could affect green sturgeon. However, to avoid negative effects, new exterior drainage gates would be installed within one low tide, without excavation or in-water work. If these requirements are followed, this work will not adversely affect these fish.

New exterior drainage gates may incrementally increase the amount of drainage water entering the tidal sloughs. Changes in salinity concentration might occur if several land areas drain into a small slough simultaneously. Such effects should be minimal because the resulting salinity would likely be within the salinity tolerance range for green sturgeon.

Installation of new exterior drainage gates would occur under the RGP and biological opinions, and should not adversely affect this species. USACE RGP R20066E98 requires SRCD to develop and implement a diversion screening program. So far, SRCD has installed 13 screens under this program. Screens are designed to comply with USFWS delta smelt approach velocities, which should make them protective of other sensitive fish species. To protect sensitive fish species at unscreened diversions, NMFS and USFWS have imposed restrictions that specify when landowners may divert water from sloughs.

Portable Pumps Program

Operation of portable drainage pumps would not likely affect green sturgeon. Drainage water from managed wetlands is typically more saline than channel water, which could result in a temporary localized salinity increase at the discharge site. However, Suisun Marsh channels are constantly circulating through the ebb and flood tides and the volume of water in the channels would soon dilute the more saline discharge water. Further, green sturgeon are tolerant of a wide range of salinities.

Since operation of these pumps would not change the volume of water discharged, no major changes in species distribution or abundance would be expected as a result of operating portable discharge pumps. This effect is expected to be relatively minor.

The portable pumps with fish screens would be used for diversion primarily during the late summer and fall for initial filling and during winter and spring for wetland habitat management. Pump operation would not increase the volume of water diverted and may actually protect aquatic resources. This may benefit green sturgeon and other fish as it would decrease losses due to entrainment. The pumps would be located throughout the managed wetlands, where such operation would be most effective.

Since fish screens are not one-hundred percent effective, some larval and juvenile fish could be diverted onto the interior ponded areas of the managed wetlands. However, the use of the portable pumps with fish screens would decrease diversions through existing unscreened structures. Although these screened pump diversions may affect larval and juvenile fish, there may be a net benefit to other life stages of resident and migratory fish that are not protected from entrainment by the unscreened diversions currently servicing these managed wetlands. This action may benefit green sturgeon.

Critical Habitat

There is no designated critical habitat for green sturgeon in the project area.

Existing Environmental and Cumulative Effects

Current and ongoing anthropogenic negative effects to green sturgeon and their habitat in the Suisun Marsh include the following.

- Entrainment of juvenile green sturgeon into the managed wetlands at unscreened diversion culverts during water diversions.
- Habitat degradation resulting from decreases in flows due to water diversions.

- Poor water quality, due to the presence of toxics and pesticides in the water supply. Temporary, intermittent water quality problems can arise form the draining of acidic or anoxic water from the managed wetlands into the marsh sloughs.

Conclusions and Determination

Possibly the most significant adverse effect on green sturgeon in the marsh is entrainment into managed wetlands during water diversion.

Currently, SRCD must comply with requirements specified in RGP R20066E98 that decrease the potential for fish entrainment. Amendment Three would further decrease the likelihood of mortality due to entrainment by requiring the installation of additional fish screens on water diversion culverts and portable diversion pumps. Further, it includes the Water Manager Program, which would also benefit green sturgeon, by ensuring that properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS.

These findings indicate that Amendment Three would not adversely affect green sturgeon and may actually provide some benefits to this species.

Pacific Lamprey, *Lampetra tridentata*

Status

Pacific lamprey (*Lampetra tridentata*) is designated by USFWS as a federal species of special concern.

Distribution

The following is quoted from Wang (1986).

> The Pacific lamprey, a parasitic anadromous species, has been found from Point Canoas, Baja California, to the Bering Sea and Japan (Fry 1973; Hart 1973; Miller and Lea 1972). Along the California coast, they are more abundant from Monterey northward (Moyle 1976). In the study area, Pacific lamprey were reported in the Sacramento-San Joaquin river system by Rutter (1908). In recent years, this species has been taken by trawl in San Francisco Bay (Aplin 1967), San Pablo Bay (Ganssle 1966), and Carquinez Strait (Messersmith 1966). In this study, Pacific lamprey were observed in Cache Slough, Lindsey Slough, Suisun Bay, American River (up to Nimbus Dam), the Sacramento River (up to Red Bluff Dam), Napa River, Sonoma Creek, and Walnut Creek.

Habitat

Pacific lamprey spawn in freshwater environments where there are riffles, usually over gravel and rocks, and occasionally over sand (Wang 1986). Ammocoetes live in fresh water or estuarine environments with sandy or soft mud substrates. After five to six years, physiological changes occur and the adult lamprey migrates to the ocean. After one or two years, the lamprey returns to fresh water to spawn.

General Ecology

The following is quoted from Wang (1986).

> The life history of this species in the British Columbia area has been reported by Pletcher (1963). The following information is a personal observation at a nesting site in Walnut Creek, unless otherwise noted. Spawning takes place in riffle areas where the current is swift. Both sexes construct the nest in gravel and occasionally use sandy substrates. The depth of water at the nest sites is usually less than one in ... During mating, the female attaches to a rock on the upstream side of the nest and the male attaches to the head of the female (Scott and Crossman 1973), or both attach to the rocks and lie close to each other, but are not necessarily parallel to the current flow. Both of them “vibrate” rapidly for a few seconds when the milt and eggs are released (Scott and Crossinan 1973). Eggs are slightly adhesive and cannot sustain the rapid current. As a result, most eggs are washed into the crevices of the rocks on the downstream side of the nest. Hatching occurs in about 19 days at 15 0C (Hart 1973). Males may mate with more than one female in different nests (Pletcher 1963). In the American River, many lamprey nests were found in close proximity. During disturbances, the lampreys move between adjacent nests. Adults die after spawning (Scott and Crossman 1973; Moyle 1976; this study). The eggs of California roach and Sacramento sucker were occasionally observed in lamprey nests.
>
> The caudal region of the newly hatched ammocoete is initially bent ventrally, but straightens within a short time. The ammocoetes remain in the crevices of the rocks,

and then swim up into the current. Ammocoetes are carried to suitable areas of soft mud and sand (Moyle 1976). They are also found in areas of coarse sand. They burrow tail first into substrates or sometimes lie on top of the substrates and move from one place to another. Ammocoetes are filter feeders, subsisting on algae and organic matter (Moyle 1976). The ammocoete stage may last five to six years (Scott and Crossman 1973; Hart 1973) or three to seven years (Moyle 1976). They are found in freshwater streams and estuaries as free swimmers. They were more often observed during winter and spring high flow seasons.

McPhail and Lindsey (1970) described the physical changes of transformation of ammocoetes into predatory adults, which occur when they are about 14 to 16 cm in length. The lip or oral hood becomes an oral sucking disc, flanked by a series of leaf-like laminae on the margin of the disc. Horny plates (or teeth) appear in the mouth, the eyes enlarge, and the snout elongates. When the transformation is completed, downstream migration begins, usually in spring (Hart 1973), and the lampreys become parasitic when they arrive in the ocean. The parasitic life lasts about one to two years before they return to fresh water (Scott and Crossman 1973; Moyle 1976).

The Pacific lamprey during its parasitic life stage causes damage to marine fish, including striped bass and salmon (Kimsey and Fisk 1964), but the mortality is low. Fry (1973) commented that West Coast fish and lampreys have lived with (and on) each other for many generations and are self-adjusted to the relationship.

Occurrence in the Project Area

Pacific lampreys have been captured somewhat infrequently by the UC Davis Suisun Marsh Sampling Program (Matern and others 1997). These fish have only been captured during nine of the 19 years of the study, in 1981, 1982, 1986, 1987, 1992, and 1995 through 1997. During five of those years, only one lamprey was caught, while in 1981, 1982, and 1992 between two and six were captured. In 1995, 19 Pacific lamprey were captured. Suisun Marsh is not identified as a spawning ground for this fish (Wang 1986; Matern and others 1997).

Project Impacts

The following Amendment Three actions will have no effect on Pacific lamprey because they will be conducted exclusively in the managed wetlands or use structures that are equipped with fish screens.

- Managed Wetland Improvement Fund.
- Drought Response Fund.
- Roaring River Distribution System turnout repairs.
- Updating management plans.

Actions that could potentially affect Pacific lamprey are described below, including several actions which will not affect the fish, but for which explanation is helpful.

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

The potential effects to special status species were addressed in the Environmental Report (Appendix 1) of the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 1995). SWRCB concluded that the standards should

preserve a salinity gradient within the unmanaged tidal marshes of the estuary, including the Suisun Marsh. The proposed increases in freshwater outflow are within the historical salinity ranges and are not expected to adversely affect Pacific lamprey.

The proposed Amendment Three channel salinity standards should not affect the natural (east-west and north-south) salinity gradient in the marsh. The salinity standards are upper limits, as are those required by SWRCB permit conditions in Order WR 98-9. These standards do not establish lower salinity limits. Except in very wet years, the natural salinity gradient would be higher in the western marsh as expected under the natural gradient. In addition, the original SMPA and water right permit standards do not interfere with the natural gradient because they provide for defined "deficiency periods" with appropriate relaxation of standards. These standards allow for increased salinity in the western marsh during drier years as would occur under a natural salinity gradient. They should have no adverse affect on Pacific lamprey.

Converting S-35 and S-97 to Monitoring Stations

By converting S-35 and S-97 to monitoring stations, channel water salinity in the western marsh would, at times, be higher than Order WR 98-9 standards. This would not adversely affect the ammocoetes, which can tolerate fresh and brackish conditions, nor would it affect the adult Pacific lampreys, which are tolerant of a wide range of salinities.

Establishing Criteria for September SMSCG Operations

September SMSCG operations would not adversely affect Pacific lamprey. Pacific lamprey have a wide salinity tolerance range, and the ammocoetes are tolerant of fresh and brackish conditions. Thus changes in salinity due to SMSCG operations are not likely to affect this species or its habitat. These fish would not be migrating through the marsh during September, thus September SMSCG operations would not impede their movement.

Morrow Island Distribution Fish Screens

This action may benefit Pacific lamprey and other fish. Placing a fish screen on the intake to the Morrow Island Distribution System will decreased the number of fish diverted into the system and entrained by the intakes, thus decreasing the amount of mortality that occurs as a result of entrainment. While no screening technique is one-hundred percent effective, the presence of screens will reduce entrainment substantially.

Lower Joice Island Unit Fish Screen

This action may benefit Pacific lamprey and other fish. Placing a fish screen on the Lower Joice Island Unit will decrease the number of fish diverted into the system and entrained by the intakes, thus decreasing the amount of mortality that occurs as a result of entrainment. While no screening technique is one-hundred percent effective, the presence of the screens will reduce entrainment substantially.

Water Manager Program

This action may benefit Pacific lamprey and other fish. The USFWS 1994 biological opinion indicates that water diversions can have an adverse effect on certain fish, by entraining adult or larval fish or by decreasing outflows incrementally. The water manager is responsible for monitoring the flood and drain periods to ensure that the properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS. This monitoring will help prevent unnecessary diversions from the sloughs and bays. The water manager would monitor the operation of fish screen facilities on private property and perform routine maintenance to ensure that screen operation is in compliance

with design criteria for the facility. By decreasing unnecessary water diversions and the possibility of entrainment, this action may benefit this species.

Joint-use Facilities Program

Circulation and drainage ditch maintenance would occur inside the managed wetlands, so there would be no effects to Pacific lamprey.

Increased turbidity due to installment of exterior drainage gates could affect Pacific lamprey. However, to avoid negative effects, new exterior drainage gates would be installed within one low tide, without excavation or in-water work. If these requirements are followed, this work will not adversely affect these fish.

New exterior drainage gates may incrementally increase the amount of drainage water entering the tidal sloughs. Changes in salinity concentration might occur if several land areas drain into a small slough simultaneously. Such effects should be minimal, because the resulting salinity would likely be within the salinity tolerance range for Pacific lamprey.

Installation of new exterior drainage gates would occur under the RGP and biological opinions, and would have no adverse affect on Pacific lamprey. USACE RGP R20066E98 required SRCD to develop and implement a diversion screening program. So far, SRCD has installed 13 screens under this program. Screens are designed to comply with USFWS delta smelt approach velocities, which should protect other sensitive fish species. To protect sensitive fish species at unscreened diversions, NMFS and USFWS have imposed restrictions that specify when landowners may divert water from sloughs.

Portable Pumps Program

Operation of portable drainage pumps could have a minor, temporary effect on Pacific lamprey. Drainage water from managed wetlands is typically more saline than channel water, which could result in a temporary localized salinity increase at the discharge site. However, Suisun Marsh channels are constantly circulating through the ebb and flood tides and the volume of water in the channels would soon dilute the more saline discharge water.

Since operation of these pumps would not change the volume of water discharged, no major changes in species distribution or abundance would be expected as a result of operating portable discharge pumps. This effect is expected to be relatively minor.

The portable pumps with fish screens would be used for diversion primarily during the late summer and fall for initial filling and during winter and spring for wetland habitat management. Pump operation would not increase the volume of water diverted and may actually protect aquatic resources. This may benefit Pacific lamprey and other fish as it would decrease losses due to entrainment. The pumps would be located throughout the managed wetlands, where such operation would be most effective.

Since fish screens are not one-hundred percent effective, some larval and juvenile fish could be diverted onto the interior ponded areas of the managed wetlands. However, the use of the portable pumps with fish screens would decrease diversions through existing unscreened structures. Although these screened pump diversions may affect larval and juvenile fish, there may be a net benefit to other life stages of resident and migratory fish that are not protected from entrainment by the unscreened diversions currently servicing these managed wetlands.

This action may benefit Pacific lamprey.

Critical Habitat

There is no designated critical habitat for Pacific lamprey in the project area.

Existing Environment and Cumulative Effects

Current and ongoing anthropogenic negative effects to Pacific lamprey and their habitat in the Suisun Marsh include the following.

- Entrainment of Pacific lamprey into the managed wetlands at unscreened diversion culverts during water diversions.
- Habitat degradation resulting from decreases in flows due to water diversions.
- Poor water quality, due to the presence of toxics and pesticides in the water supply. Temporary, intermittent water quality problems can arise from the draining of acidic or anoxic water form the managed wetlands into the marsh sloughs.

Conclusion and Determination

Probably the most significant adverse effect on Pacific lamprey in the marsh is entrainment into managed wetlands during water diversion. Currently, SRCD must comply with requirements specified in RGP R20066E98 that decrease the potential for fish entrainment. Amendment Three would further decrease the likelihood of mortality due to fish entrainment by requiring the installation of additional fish screens on water diversion culverts and portable diversion pumps. Further, it includes the Water Manager Program, which would also benefit Pacific lamprey, by ensuring that properties without screened diversions comply with mandatory diversion restrictions required by USACE, USFWS, and NMFS.

These findings indicate that Amendment Three would not adversely affect Pacific lamprey in Suisun Marsh, and may actually benefit this species.

Chapter 10
PLANTS

Suisun Marsh aster, *Aster lentus*

Status

Suisun Marsh aster (*Aster lentus*) is identified as a species of concern by the USFWS, and is on List 1B of the California Native Plant Society's Plants Rare, Threatened, or Endangered in California and Elsewhere.

Distribution

Suisun Marsh aster is endemic to Suisun Marsh and is known from several locations in the Sacramento-San Joaquin Delta and the marshes associated with the Napa River north of San Pablo Bay. Populations have been documented in Sacramento, San Joaquin, Solano, Contra Costa, and Napa counties (CNPS 1994; NDDB 1998).

Habitat

Suisun marsh aster is known to brackish and freshwater marshes. It occurs along brackish sloughs and riverbanks affected by tidal fluctuations. Associated plant species include other species that occur in wetlands including bulrushes, cattails, and rushes. The plant is most commonly found at or near the water's edge on the water side of delta and marsh levees. Suisun Marsh aster has also been observed on the landward side of channel levees along irrigation and drainage ditches in the delta, and along water distribution ditches of managed wetlands in Suisun Marsh. Internal marsh channels such as distribution or drainage ditches which are in areas with high water tables, or in areas that retain water through the year may support populations of Suisun Marsh aster.

General Ecology

Suisun Marsh aster is a member of the sunflower family (Asteraceae). This fall-blooming perennial has many violet-colored ray flowers. Very little is known about the ecology, demography, and critical life stages of Suisun Marsh aster.

This species was formerly known as Aster chilensis var. lentus as described in Munz and Keck (1968). Nomenclature according to the Jepson taxonomy (Hickman and others 1993) is Aster lentus, and the species is known to grade into A. chilensis (Hickman and others 1993), which is more common throughout Suisun Marsh. A second fall-blooming aster, Aster subulatus var. ligulatus is also common in Suisun Marsh, and could be mistaken for the sensitive perennial aster.

Occurrence in the Project Area

Field surveys have located Aster lentus throughout most regions of Suisun Marsh. Detailed surveys for this aster were conducted in October 1991, October 1992, and October 1993 during the peak bloom period of this species. Department of Water Resources and Department of Fish and Game survey teams inspected all channel banks in the Western Salinity Control Project areas from shallow draft boats, and transects were walked through tidal marsh areas which were not visible from the channel. In addition, a marsh-wide survey

for the species was conducted in 1992 for the Suisun Marsh biological assessment for SWRCB. These surveys were conducted by Department of Water Resources and Department of Fish and Game survey from shallow draft boats.

The purple blossoms of this fall blooming member of the sunflower family are a common October sight along western Suisun marsh channels where population densities are greatest. Aster chilensis var. lentus was been observed on the water side of the levees of Cordelia Slough, Ibis Cut, Frank Horan Slough, Chadbourne Slough, Suisun Slough, and Goodyear Slough in western Suisun Marsh. It is also known to Montezuma Slough, Nurse Slough, Denverton Slough, Luco Slough, Cutoff Slough, Peytonia Slough, and Hill Slough. Suisun aster may be found along small tidal creeks within the undiked tidal marshes associated with Cutoff Slough, Peytonia Slough, Hill Slough, and Roe Island. Some of these populations which were located prior to taxonomic revision of the species may no longer be identified as Aster lentus.

Aster lentus has been documented along the inside channel banks of the Morrow Island Distribution System (Witzman, DWR Internal Memo, 1996), in the Peytonia Slough Ecological Reserve and along Cordelia Slough near the S-97 salinity monitoring station (Grewell, 1996 and 1997 field observations), and along other distribution ditch banks in some managed seasonal wetlands of Suisun Marsh. As comprehensive floristic surveys of private wetlands and marsh channels have not been conducted for Aster lentus, it is possible this species is also present along distribution and drainage ditches within managed seasonal wetlands of Suisun, and along the outboard sides of levees.

Project Impacts

The following Amendment Three actions are not expected to affect Suisun Marsh aster.

- Morrow Island and Lower Joice Island fish screens.
- Updating management plans.
- Converting S-35 and S-97 to monitoring stations.
- Water Manager Program.
- Making water quality standards consistent with the 1995 Water Quality Control Plan.
- Establishing criteria for September SMSCG operations.
- Roaring River Distribution System turnout repairs.

Managed Wetlands Improvement Fund

The Managed Wetlands Improvement Fund may affect the Suisun Marsh aster. Construction of internal drainage ditches within managed seasonal wetlands could create marginal habitat for this species, and this habitat would be subjected to ongoing maintenance activities which could potentially have a negative effect on populations which may establish.

Drought Response Fund

The Drought Response Fund will increase activities within the managed wetlands, such as ditching and pumping. The presence of Suisun Marsh aster has not been documented within the managed wetlands, so this action will probably not have negative effects on the species.

Joint-use Facilities Program

The Joint-use Facilities Program may affect the Suisun Marsh aster. Replacement or installation of tide gates in outboard levees has the potential to directly remove populations of Suisun Marsh aster. Floristic surveys should be conducted during October to determine the presence of this perennial species. If found, facilities should be located at alternative sites to avoid adverse effects.

Portable Pumps Program

The use of portable pumps is not expected to affect Suisun Marsh aster, however, the replacement or installation of tide gates in outboard levees has the potential to directly remove populations. To avoid negative effects, floristic surveys could be conducted during October to determine the presence of this perennial species, and facilities could be located at alternative sites to avoid adverse effects.

Critical Habitat

There is no designated critical habitat for Suisun Marsh aster in the project area.

Existing Environment and Cumulative Effects

Extensive levee work and fish screen installation in Suisun Marsh have likely removed water side populations of this rare plant, as surveys for the presence of the species must be conducted between September and October to document presence before projects proceed. It is impossible to positively identify this perennial plant outside of the fall bloom period. Fall surveys for the presence of this plant at proposed project sites are not routinely conducted in Suisun Marsh.

Additional potential threats to Suisun Marsh aster populations include dredging close to shorelines, deposition of dredge spoils on levee banks of tidal sloughs and managed wetlands distribution ditches, adding riprap to outboard levees, oil spills, accelerated erosion caused by jet skis and excessive motor boat wake, and agricultural grazing along tidal slough banks (NDDB 1998, CNPS 1998).

Conclusion and Determination

Cost-share and Joint Facilities actions which involve placement of tide gate structures in outboard levees have the potential to directly affect Suisun Marsh aster populations. With careful project planning, facilities could be located to avoid these effects.

Alkali Milk-vetch, *Astragalus tener* Gray var. *tener*

Status

Alkali milk-vetch (*Astragalus tener* var. *tener*) is an annual plant of the pea family (Fabaceae) which is identified as a species of concern by the USFWS, and is on List lB of the California Native Plant Society. The species recently underwent taxonomic review (Liston 1990).

Distribution

Alkali milk-vetch was once distributed throughout the east bay region into Yolo County, and to the Central Coast and San Joaquin Valley of California, but has been extirpated throughout most of its historical range. The only known remaining populations are in Yolo and Solano Counties (NDDB 1998). The only protected populations are at the Jepson Prairie Preserve (Solano Farmlands and Open Space Foundation) approximately four miles northeast of Suisun Marsh, and at an alkali scald on City of Woodland property which is managed as a DFG reserve for rare plants. The few remaining additional populations occur on private lands within and immediately northeast of the Suisun Resource Conservation District in Solano County.

Habitat

This rare annual pea can be locally abundant and may be found in vernally moist areas, particularly at the margins of vernal pools and alkali scalds. It is known to alkaline playa lakes or inundated, claypan, vernal playa-type pools (Hickman, 1993; NDDB 1998; Jepson Prairie Docent Program 1998). Agricultural development and heavy grazing have destroyed much of the historical habitat of this California endemic (CNPS 1994).

General Ecology

Alkali milk-vetch is restricted to seasonally flooded habitat with seasonally saturated soils. The species is found in both moist grasslands and at the upper margins of large, shallow, alkaline playas which form after winter rains in settings where claypan substratum impedes drainage. It is also described from alkali scald areas in annual grasslands, and from low alkali flats within seasonally flooded lands where water evaporates in spring as winter precipitation ends and temperatures increase. This annual pea blooms from March through June. The species resembles a rose-flowered clover, but may be distinguished by pinnate rather than palmate leaflet divisions. Species associates reported with alkali milk-vetch include saltgrass (*Distichlis spicata*), alkali heath (*Frankenia salina*), owl's clover (*Orthocarpus* sp.), popcorn flower (*Plagiobothyrs* sp.), and wooly marbles (*Psilocarphus* sp.). In Suisun Marsh, this rare plant co-occurs with the rare Contra Costa goldfields (*Lasthenia conjugens*) and San Joaquin saltbush (*Atriplex joaquiniana*). In Yolo County, the rare milk-vetch co-occurs with the endangered palmate bird's beak (*Cordylanthus palmatus*) and a rare native peppergrass (*Lepidium nitidum* var. *howellii*). Populations of alkali milk-vetch have also been described without these rare plant associates. There is little known regarding the critical life stages and general ecology of this rare plant.

Occurrence in the Project Area

There are large alkali playa lake vernal pool complexes flanking the north east base of the Potrero Hills between Hill Slough and Union Creek and Luco Slough and Denverton Creek in northeastern Suisun Marsh. The margins of these pools may support alkali milk-vetch.

There are other vernal moist grasslands with vernal pool soils at the margins of private managed seasonal wetlands around the upper reaches of Hill Slough, Luco Slough, Denverton Creek, and along the wetland-upland ecotone of eastern Suisun Marsh from Denverton to Montezuma. There are also alkali scald areas within managed seasonal wetlands throughout Suisun Marsh which support the common plant associates of alkali milk-vetch and have the potential to support this rare plant. Searches for alkali milk-vetch have been limited on private properties, and it is possible the species is more extant in Suisun Marsh. The presence of this species has been documented near the terminus of Hill Slough immediately east of the Potrero Hill Landfill access road (NDDB 1998). A significant population of this rare plant has also been described near the SMSCG day use area access road west of Collinsville Road in the proposed Montezuma Wetlands project area (NDDB 1998).

Project Impacts

The following Amendment Three actions are not expected to affect alkali milk-vetch.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Establishing criteria for September SMSCG operations.
- Roaring River Distribution System turnout repairs.
- Morrow Island and Lower Joice Island fish screens.

Managed Wetlands Improvement Fund

Physical drainage improvements and management actions which eliminate poorly drained alkali scald areas within these properties preventing evaporation of seasonally ponded water could eliminate alkali milk-vetch if present. However, a floristic census within the levees of privately owned managed wetlands has not been conducted for the presence of rare plants.

Drought Response Fund

Physical drainage improvements and management actions which eliminate poorly drained alkali scald areas within these properties preventing evaporation of seasonally ponded water could eliminate alkali milk-vetch if present.

Updating Management Plans

Funding of updates to the management plans will not affect alkali milk-vetch. However implementation of management actions recommended in the updated plans have the potential to affect alkali milk-vetch, if it occurs in the managed wetlands. Physical drainage improvements and management actions which eliminate poorly drained alkali scald areas within these properties preventing evaporation of seasonally ponded water could eliminate alkali milk-vetch if present.

Water Manager Program

Funding the Water Manager Program will not affect alkali milk-vetch. However, the activities that the water manager may recommend have the potential to affect alkali milk-vetch, though to date floristic census within the levees of privately owned managed wetlands has not been conducted for the presence of rare plants. Physical drainage improvements and management actions which eliminate poorly drained alkali scald areas within these properties preventing evaporation of seasonally pon-

ded water could eliminate alkali milk-vetch if present.

Joint-use Facilities Program

Physical drainage improvements and management actions which eliminate poorly drained alkali scald areas within these properties preventing evaporation of season-ally ponded water could eliminate alkali milk-vetch if present.

Portable Pumps Program

Physical drainage improvements and management actions which eliminate poorly drained alkali scald areas within these properties preventing evaporation of season-ally ponded water could eliminate alkali milk-vetch if present.

Critical Habitat

There is no designated critical habitat for alkali milk-vetch in the project area.

Existing Environment and Cumulative Effects

Current populations of alkali milk-vetch are threatened by cattle and sheep grazing. Additional potential threats include nearby landfill, future urban development, and conversion of habitat in the proposed Montezuma Wetlands Project (NDDB 1998). Construction of a subdivision has already occurred over alkali milk-vetch habitat (vernal alkali flats and vernal pool soils) south of Highway 12 within the Suisun Resource Conservation District. Construction of the Lawler Ranch buffer ditch channel north of Hill Slough cut through sections of chenopod scrub habitat and traversed vernal pool soils and mima mound topography. Surveys for alkali milk-vetch were not conducted in association with this project, but potential habitat for the species was removed.

Conclusion and Determination

The Managed Wetlands Improvement Fund, Water Manager Program, Joint-use Facilities, and Portable Pumps alternatives have the potential to affect alkali milk-vetch through habitat alteration though surveys to document the presence of this species have not been conducted within the managed wetlands.

Heartscale, Atriplex cordulata

Status

Heartscale (Atriplex cordulata) is identified as a species of concern by the USFWS, and is on List lB of the California Native Plant Society.

Distribution

Heartscale was historically known to valley and foothill grasslands throughout the Sacramento and San Joaquin Valleys and the San Francisco Estuary. Historical populations known to Yolo County near Davis and Elmira of Solano County are now extirpated. The species was also historically reported from Byron Hot Springs and from several sites in the southern San Joaquin Valley (NDDB 1998). Protected populations are present at Sacramento National Wildlife Refuge and Gray Lodge Wildlife Management Area in the Sacramento Valley. Heartscale is also known to the Creed Road area of Solano County between Suisun Marsh and Jepson Prairie, Calhoun Cut near Jepson Prairie, and the Collinsville area of Solano County.

Habitat

This rare Atriplex species occurs in saline or alkali areas within chenopod scrub, and within sandy valley and foothill grasslands (Skinner and Pavlik 1994). It is known to alkali soils within and adjacent to seasonal marsh (Jones and Stokes Associates 1995). It has been observed within scrub vegetation on a levee in Suisun Marsh (Ruygt in USACE and Solano County 1994).

General Ecology

Heartscale is a small, low-growing annual of the goosefoot family (Chenopodiaceae). The plant produces one to several stems up to 50 cm tall which bear scattered gray scaly leaves with heart-shaped leaf bases. There is very little known of the general biology, critical life stages, or ecology of this rare Atriplex.

Occurrence in the Project Area

Heartscale has been recently reported from the Suisun Resource Conservation District. A single individual was found on the outboard side of the Montezuma Slough levee near the Suisun Marsh Salinity Control Structure during rare plant searches associated with the Montezuma Wetlands Project (Ruygt in USACE and Solano County 1994; Fiedler and Zebell 1995). More extant habitat for this species occur within managed wetlands and adjacent uplands, and on levees throughout the Suisun Marsh, but marshwide floristic searches for this species have not been conducted. The species was not included in previous surveys associated with the Western Salinity Control Project, because at that time the DFG and USFWS did not expect it to occur in Suisun Marsh.

Project Impacts

The following Amendment Three actions are not expected to affect heartscale.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Criteria for September SMSCG operations.
- Portable Pumps Program.

- Morrow Island and Lower Joice Island fish screens.

Managed Wetlands Improvement Fund

The activities funded by this action have the potential to affect heartscale as this rare plant has been documented as part of the levee vegetation in Suisun Marsh. Additional populations of heartscale may be present within the Suisun Marsh, although floristic census on and within the levees of privately owned managed wetlands has not been conducted. Installation of tide gates could directly affect heartscale.

Drought Response Fund

Drought response funding that would increase discing, burning, and herbicide use could affect this annual species.

Updating Management Plans

Funding the updates to the management plans is not expected to affect heartscale. Although, if management objectives to remove chenopod scrub communities in favor of more emergent vegetation such as bulrushes are recommended, the heartscale plant community may be affected. Routine discing, burning, and herbicide use could also affect this annual species.

Water Manager Program

Additional populations of heartscale may be present within the Suisun Marsh, although fibristic census on and within the levees of privately owned managed wetlands has not been conducted. If the Water Manager recommends management objectives to remove chenopod scrub communities in favor of more emergent vegetation, the heartscale plant community may be affected.

Joint-use Facilities Program

The Joint-use Facilities alternative may affect heartscale as this rare plant has been documented as part of the levee vegetation in Suisun Marsh. Additional populations of heartscale may be present within the Suisun Marsh, although floristic census on and within the levees of privately owned managed wetlands has not been conducted. Installation of tide gates, or levee maintenance activities could directly affect heartscale.

Critical Habitat

There is no designated critical habitat for heartscale in the project area.

Existing Environment and Cumulative Effects

The current population of heartscale is threatened by levee maintenance activities near the SMSCG. Throughout its range, heartscale is threatened by conversion of native grassland and alkali sink to agriculture, high grazing pressure, and urban development.

Conclusion and Determination

The Managed Wetlands Improvement Fund, Water Manager Program, and Joint-use Facilities alternatives have the potential to affect heartscale through management actions which alter habitat to discourage the growth of saltgrass, and associated chenopod vegetation. Routine maintenance actions on managed wetlands such as discing, burning, herbicide use, and fence construction may also affect valley heartscale. As heartscale is known to occupy a Suisun Marsh levee, levee maintenance activities such as placement of riprap or herbicides could directly affect the species. Floristic surveys for this species will be conducted before work activities begin. If heartscale is found, the project could be relocated to avoid negative effects.

Brittlescale, *Atriplex depressa*

Status

Brittlescale (*Atriplex depressa*) is identified as a species of concern by the USFWS, and is on List lB of the California Native Plant Society. Brittlescale was previously included in the species A triplex parish ii, but underwent recent taxonomic review and is believed to be more rare than was previously believed (Taylor and Wilken 1993).

Distribution

Brittlescale is endemic to the lower Sacramento and upper San Joaquin valleys and greater San Francisco Bay and Delta regions of California. Populations are described from the Byron Hot Springs area in Contra Costa County, and Solano, Stanislaus, Glenn, Kern, and Tulare counties. Protected populations occur at Jepson Prairie Preserve (Solano County), Sacramento National Wildlife Refuge (Glenn County) and Gray Lodge Wildlife Management Area in the Butte Basin.

Habitat

Brittlescale occurs in chenopod scrub, valley and foothill grassland, meadows, alkaline playas, and vernal pools. It is usually in chenopod scrub associated with alkali scalds (NDDB 1998). This rare plant occurs in relatively barren alkaline areas which are drier than vernal pools (Jepson Prairie Docent Program 1998).

General Ecology

Brittlescale is a small, low-growing annual plant of the goosefoot (Chenopodiaceae) family. Brittlescale produces a characteristic mat of brittle branches up to 20 cm in height with dense, white-scaly leaves and red seeds. There is very little known about the general biology, life history characteristics, or details of the habitat characteristics of brittlescale.

Occurrence in the Project Area

Floristic surveys for brittlescale have not been conducted throughout Suisun Marsh. There are two reported populations discovered during environmental survey work associated with the Potrero Hills Landfill expansion and the Montezuma Wetlands projects. A small colony of brittlescale was found just north of the Montezuma Wetlands Project boundary north of Bird's Landing (Fiedler and Zebell 1995). This area is near the National Steel (S-64) monitoring station on Montezuma Slough. The colony of 300 plants was reported in 1991 from chenopod scrub near Montezuma Slough in a diked seasonal marsh of a private duck hunting club (NDDB 1998). It was found in a shallow depression with horned seablite (*Suaeda calceoliformis*), common spikeweed (*Hemizonia pungens*), bassia (*Bassia hyssopifolia*), nitrophila (Nitrophila occidentalis), perennial pickleweed (Salicornia virginica), and an additional species of pickleweed (Salicornia subterminalis) which is found at the high marsh-upland ecotone (NDDB 1998). The second known population of brittlescale is to the east of the Potrero Hills Landfill access road in alkali playa habitat (NDDB 1998). The plant associates reported with this species in 1996 were perennial pickleweed (Salicornia virginica), rabbit's foot grass (Polypogon monspeliensis), and alkali heath (Frankenia salina).

Project Impacts

The following Amendment Three actions are not expected to affect brittlescale.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-37 to monitoring stations.
- Establishing criteria for September SMSCG operations.
- Roaring River Distribution System turnout repairs.
- Morrow Island and Lower Joice Island fish screens.

Managed Wetlands Improvement Fund

Physical drainage improvements which eliminate pickleweed and chenopod associates could affect brittlescale as it is a member of this community.

Drought Response Fund

Drought Response funding that would increase discing, burning, and herbicide use could affect brittlescale.

Updating Management Plans

Funding the updates to the management plans is not expected to affect brittlescale. However, recommendations that prescribe any physical drainage improvements and man-agement actions that eliminate chenopod associates could affect brittlescale. If the updated plans call for extensive implementation of late draw-down water management schedules, this could result in reduced brittlescale habitat. Routine discing and burning activities could also eliminate this annual species is these activities occur before seed set, or if they remove the seed banks of the plant. Herbicide application in the drier areas of diked seasonal wetlands could directly affect brittlescale.

Water Manager Program

Funding the Water Manager program will not affect brittlescale. However, actions that are recommended by the program that specify physical drainage improvements and management actions that eliminate chenopod associates could affect brittlescale. More extensive implementation of late draw-down water schedules as implemented by a water manager could result in reduced brittlescale habitat.

Joint-use Facilities Program

Joint-use Facilities activities have the potential to affect brittlescale in that physical drainage improvements and management actions that eliminate chenopod associates could affect brittlescale.

Portable Pumps Program

The Portable Pumps Program may affect brittlescale in that physical drainage improvements that eliminate chenopod associates could affect brittlescale, as it is a member of this community.

Critical Habitat

There is no designated critical habitat for brittlescale in the project area.

Existing Environment and Cumulative Effects

Current populations of brittlescale are threatened by cattle grazing pressure, and duck club operation activities including fence construction and herbicide application (NDDB 1998). Construction of a subdivision has already occurred over brittlescale habitat (vernal alkali flats and areas of chenopod scrub) south of Highway 12 and north of Hill Slough within the Suisun Resource Conservation District.

Conclusion and Determination

Selection of the Managed Wetlands Improvement Fund, Water Manager Program, Joint-use Facilities, Portable Pumps alternatives and implementation of Drought Response Funding actions and Updated Management Plans have the potential to affect brittlescale through management actions that alter habitat to discourage the growth of saltgrass, and associated chenopod vegetation. Routine maintenance actions on managed wetlands such as discing, burning, herbicide use, and fence construction may also affect brittlescale.

Valley Spearscale, *Atriplex joaquiniana*

Status

Valley spearscale (*Atriplex joaquiniana*), also known as San Joaquin spearscale, is identified as a species of concern by the USFWS, and is on List lB of the California Native Plant Society.

Distribution

Valley spearscale occurs in the San Joaquin and Southern Sacramento valleys, Suisun Marsh, and the San Francisco Estuary of California (NDDB 1998; Skinner and Pavlik 1994). Populations are known to Alameda County, Livermore, Byron Hot Springs, Kesterson National Wildlife Refuge, Sacramento National Wildlife Refuge, San Benito County, the Clifton Court Forebay area, and Suisun Marsh (NDDB 1998).

Habitat

Valley spearscale occurs on alkaline soils in alkali meadows and grassland, and especially in low alkali flats within seasonally flooded lands where water evaporates in spring as winter precipitation ends and temperatures increase. The plant has been found in meadows, seeps, valley and foothill grasslands, and in seasonal wetlands. It is known to alkali sink scrub communities including salt grass (*Distichlis spicata*), alkali heath (*Frankenia salina*), and fat hen (*Atriplex triangularus*). It has been found in alkali playas adjacent to tidal salt marsh and within diked seasonal wetlands. It has been found with fat hen and saltgrass along drainage banks and in open salt flats in the Slaughterhouse Point area of the Napa Marsh (NDDB 1998). At some sites it co-occurs with the rare Contra Costa goldfields (*Lasthenia conjugens*), alkali milk-vetch (*Astragalus tener* var. *tener*), and heartscale (*Atriplex cordulata*).

General Ecology

Valley spearscale occurs in alkaline areas within chenopod scrub communities and grasslands. This herbaceous annual of the Goosefoot family (Chenopodiaceae), is typically a meter tall, and bears ovate to triangular, wavy-toothed, gray, scaly leaves that are greatly reduced in size near the top of the plant. It is distinguished from other annual Atriplex by its striate stem and triangular, ribbed, and free-fruiting bracts. There is very little known about the biology, critical life stages, or general ecology of Valley spearscale.

Occurrence in the Project Area

Populations of valley spearscale have been documented within the Suisun Resource Conservation District of Suisun Marsh. Valley spearscale was recorded in association with the rare alkali milk-vetch and Contra Costa goldfields in seasonally flooded alkali flats immediately east of Hill Slough in the vernal pool and drainage habitat adjacent to the north flank of the Potrero Hills (Jones & Stokes 1995; NDDB 1998). Valley spearscale was also documented at Montezuma Wetlands Project site between Montezuma and Collinsville (USACE 1994; NDDB 1998). A small population of 100 plants were found in a saline flat within a diked pasture near Montezuma in association with alkali weed (*Cressa truxillensis*), alkali heath (*Frankenia salina*), and Mediterranean barley (*Hordeum marinum*) (NDDB 1998). Department of Fish and Game surveys associated with the Western Suisun Marsh Salinity Control Project documented valley spearscale in a seasonal alkali flat on private property in the northwestern Suisun Marsh in the vicinity

of the proposed Boynton-Cordelia Ditch alignment (Allen 1991). Although comprehensive floristic surveys have not been conducted, valley spearscale may be extant in other diked seasonal wetlands of Suisun.

Project Impacts

The following Amendment Three actions are not expected to affect valley spearscale.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Converting S-35 and S-97 to monitoring stations.
- Establishing criteria for September control gate operations.
- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repairs.

Managed Wetlands Improvement Fund

The physical drainage improvements that are implemented which eliminate poorly drained alkali scald areas with these properties preventing evaporation of season-ally ponded water could eliminate valley spearscale, as the species occupies this habitat.

Drought Response Fund

Drought Response funding that would increase routine discing and burning activities could also eliminate this annual species if these activities occur before seed set, or if they remove the seed bank.

Updating Management Plans

Funding the updates to the management plans is not expected to affect brittlescale. However, recommendations within the plan for any physical drainage improvements and management actions that are recommended which eliminate poorly drained alkali scald areas within privately owned managed wetlands could eliminate valley spearscale, although complete floristic census within the levees of these properties has not been conducted for the presence of rare plants. Routine discing and burning activities could also eliminate this annual species if these activities occur before seed set, or if they remove the seed bank of the plant.

Water Manager Program

Funding the Water Manager program will not affect valley spearscale, although management actions that eliminate poorly drained alkali scald areas within these properties valley spearscale could be affected as the species occupies this habitat.

Joint-use Facilities Program

Joint-use Facilities alternatives have the potential to affect valley spearscale though to date complete floristic census within the levees of these properties has not been conducted for the presence of rare plants. Physical drainage improvements and management actions which eliminate poorly drained alkali scald areas with these properties could eliminate valley spearscale, as the species occupies this habitat.

Portable Pumps Program

The Portable Pumps alternatives have the potential to affect valley spearscale though to date complete floristic census within the levees of these properties has not been conducted for the presence of rare plants. Physical drainage improvements which eliminate poorly drained alkali scald areas could eliminate valley spearscale, as the species occupies this habitat.

Critical Habitat

There is no designated critical habitat for valley spearscale in the project area.

Existing Environment and Cumulative Effects

Current populations of valley spearscale are threatened by intensive cattle grazing pressure, a nearby landfill, future development, and conversion of habitat in the proposed Montezuma Wetlands Project (NDDB 1998). Discing and burning activities in existing diked seasonal wetlands and diked farmed wetlands have the potential to affect this species. Construction of a subdivision and "buffer" channel has already occurred over valley spearscale habitat (vernal alkali flats) south of Highway 12 and north of Hill Slough within the Suisun Resource Conservation District.

Conclusion and Determination

Selection of the Managed Wetlands Improvement Fund, Water Manager Program, Joint-use Facilities, and Portable Pumps alternatives and increased management through Drought Response Funding and implementation of updated management plans may affect valley spearscale through management actions which alter its chenopod scrub habitat. Routine maintenance actions on managed wetlands such as discing, burning, herbicide use, and fence construction may also affect valley spearscale.

Suisun Thistle, *Cirsium hydrophilum* var. *hydrophilum*

Status

Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*) is listed an endangered under the federal ESA, and is a State species of concern in California. This species was formerly described as Carduus hydrophilus Greene (Greene 1892), and Cnicus breweri Gray var. vaseyi (Gray 1988). Jepson was the first to apply the taxonomic designation Cirsium hydrophilum to the species. This plant was at one time thought to be extinct due to hybridization with the introduced bull thistle (*C. vulgare*) (CNPS 1994), and the fact that it had not been collected in over 15 years. Distinct populations of Suisun thistle were rediscovered in Suisun Marsh in 1991 and 1992. The species is taxonomically described in Hickman 1993.

Distribution

The thistle is endemic to Suisun Marsh. Historical regional floras and herbarium records suggest that it never occurred outside of Suisun Marsh. There is very little information on the historical distribution of this species within Suisun Marsh, but Greene reported it to be very common in the brackish marshes of Suisun Bay "within reach of tide water" in the late 19th century before dikes were prevalent (Greene 1892).

Habitat

Suisun thistle is a biennial to perennial herb which grows from a basal vegetative rosette, reproduces by seed, and then dies. This rare thistle is found along regularly flooded estuarine intertidal banks (Fiedler and Zebell 1995). The thistle is found along the banks of small, first-order tidal creeks of undiked marshes, and along the banks of mosquito ditches located within the lower high marsh intertidal zone (Grewell, field notes 1991 through 1998; DWR 1994). The slight natural levees of tidal creeks and mosquito ditches are slightly better drained than adjacent marsh plains. Physical conditions within the occupied habitat of Suisun thistle are influenced by precipitation, local watershed inflows, and manipulation of major tidal channel hydrodynamics and salinity through operation of the SMSCG.

Plant associates of Suisun thistle include salt grass (*Distichlis spicata*), perennial peppergrass (*Lepidium latifolium*), marsh cinquefoil (*Potentilla anserina* var. *pacifica*), swamp senecio (*Senecio hydrophilus*), threesquare bulrush (*Scirpus americanus*), water hemlock (*Cicuta bolanderi*), and western goldenrod (*Euthamia occidentalis*). Seedlings of Suisun thistle may need gaps in vegetation cover to establish. Dense cover of salt grass, marsh cinquefoil, and threesquare bulrush in wet water years appears to close gaps, and preclude germination of this species. The continued spread of perennial peppergrass is resulting in competition with this rare herb.

General Ecology

Suisun thistle is a biennial member of the sunflower family (Asteraceae). This tall thistle reaches heights of up to 2.1 meters, and has lobed spiny leaves that are greatly reduced in size near the top of the plant. The flower heads have pale rose-purple corollas and bear distinctive sticky, glandular phyllary midribs. The species begins active spring growth from basal rosettes. This active growth period varies with water year type. In the dry springs of 1992, 1993, 1994 the plants displayed vegetative growth in April, and flowering commenced in May with peak bloom observed in early June.

Suisun thistle is limited to the banks of small first order tidal channels in the upper elevational zones of undiked natural tidal marsh habitat. It is also found along mosquito recirculation ditches in high marsh zones. Potential threats to the species include conversion of undiked natural tidal marsh to diked seasonal wetlands, water development projects such as tide gate structures which alter the natural tidal hydrologic regime, urban encroachment on sensitive marsh habitat, vehicular and mechanical equipment operations associated with mosquito abatement activities, and cattle grazing in tidal marsh areas.

Occurrence in the Project Area

Department of Water Resources rare plant surveys in Suisun Marsh have documented the presence of two populations of Suisun thistle (DWR 1994). Extensive searches for this plant have been made in suitable undiked tidal wetland habitat throughout the marsh. A very small population of Suisun thistle occurs along a first order tidal creek at Peytonia Slough Ecological Reserve (DWR 1994). Suisun thistle is locally abundant along very small first order tidal creeks of the Cutoff Slough and Potrero Hills tidal marshes at Rush Ranch, and has expanded to occupy mosquito ditches near the upland ecotone which are similar in size to first order tidal creeks (DWR 1994).

There is very little relict undiked tidal marsh habitat remaining in the western Suisun Marsh. Most of the historical tidal marshes have been converted to managed seasonal wetlands. Department of Water Resources and Department of Fish and Game floristic surveys in diked wetlands have been limited to six private hunting clubs which participated in a habitat monitoring program, DFG diked lands within Suisun, and private properties on proposed project alignments in the Suisun Marsh Western Salinity Control Project. Suisun thistle has not been detected within diked wetlands in any of these surveys. Department of Fish and Game biologists have ground-truthed aerial photographs for on-site vegetation composition throughout Suisun Marsh every three years since 1981. Suisun thistle has not been observed by DFG in diked wetlands while conducting these vegetation field studies.

Suisun thistle was listed as part of a "thistle" vegetation group including *Cirsium hydrophilum*, *Silybum marianum* (milk thistle), and *Xanthium canadense* (cocklebur) which was inventoried in the subset of private lands during marshwide vegetation surveys by the Soil Conservation Service (SCS) in the 1970s (Miller and others 1975). Specific locations of Suisun thistle observed within these managed wetlands were not reported, as the focus of the report was on waterfowl food plants. It is possible that introduced annual thistles were incorrectly identified as Suisun thistle. Other more common introduced, annual thistles such as bull thistle were not mentioned in this report, and cocklebur was incorrectly reported as a thistle. Diking of some Suisun tidal marshes continued into the 1970s. It is possible that Suisun thistle was present in managed wetlands which had been recently diked at the time of the SCS surveys.

There have been no voucher specimens deposited in herbaria of Suisun thistle collected in Suisun managed wetlands. It has been assumed that Suisun thistle does not occur in diked managed wetlands of Suisun Marsh (USFWS 1995a). Comprehensive floristic surveys of diked managed wetlands throughout Suisun Marsh would be necessary to confirm the presence of this species in managed wetlands as reported by SCS. It is possible that Suisun thistle could occupy distribution ditch banks within managed seasonal wetlands where there is a perennially high water table as is found in areas with Joice Muck soils. Seed production and dispersal may limit the realized niche of this rare plant as remaining popula-

tions in Suisun are small and highly fragmented (Baye, personal communication, see "Notes").

Project Impacts

The following Amendment Three actions are not expected to affect Suisun thistle.

- Converting S-35 and S-97 to monitoring stations.
- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repairs.
- Updating management plans.
- Drought Response Fund.

It is uncertain whether Suisun thistle would be affected by other Amendment Three actions because it is uncertain whether Suisun thistle is on managed wetlands. Because of the uncertainty, the other actions and potential effects are described below in detail.

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

It is uncertain whether channel water salinity standards in the 1995 salinity control plan will affect Suisun thistle. To date, ecological studies of this species have not been conducted and the affect of physical processes on critical life stages of this rare species are unknown. Field observations suggest that sustained increases in water levels associated with high delta outflow as experienced in water years 1996 through 1998 may be detrimental to Suisun thistle due to competitive interactions within the tidal marsh plant communities (Suisun Ecological Workgroup Plant Subcommittee 1997). Water years with higher than average depth and duration of flooding on the marsh surface favor the spread of invasive species and competitive clonal species that have been observed to displace Suisun thistle. Maintenance of species diversity and persistence of rare species such as Suisun thistle may be tied to maintenance of long term variability in hydrologic conditions (Baye, Hickson, Vasey, personal communications, see "Notes").

Managed Wetlands Improvement Fund

It is uncertain whether the Managed Wetlands Improvement Fund action will affect Suisun thistle. If Suisun thistle is present along managed wetland distribution ditches, some of the physical actions supported by this fund may result in take of Suisun thistle. On the other hand, if Suisun thistle is supported on habitat within these managed lands it is possible that increasing the extent of drainage ditches within the diked lands may create additional habitat for the species in areas with a high water table. Areas within the managed wetlands with a dry soil profile throughout much of the year should not be expected to support Suisun thistle. Negative effects to Suisun thistle by this alternative could be avoided if comprehensive floristic surveys are conducted by a qualified botanist prior to project implementation. If distribution ditches are found to support Suisun thistle, future distribution ditches could be designed and managed to enhance habitat for this rare species.

Establishing Criteria for September SMSCG Operations

It is uncertain whether September SMSCG Operations affect Suisun thistle. Channel water salinity has historically been highest in Suisun Marsh channels during the late summer to early fall season. Operation of the SMSCG during September will artificially freshen channel water salinity during dry years, as this is one intended purpose of gate operations. Gate operations in September may also slightly increase water elevations in Montezuma Slough and tributaries close to the

SMSCG. Demographic and autecological studies which identify critical life stage responses to physical processes have not been conducted for this species. Artificial manipulation of water levels in Suisun thistle habitat during September could potentially affect seed dispersal and seed bank ecology of this species.

Water Manager Program

It is uncertain whether the Water Manager Program will affect Suisun thistle, as it is uncertain whether Suisun thistle occurs in the managed wetlands. If comprehensive floristic surveys detect the presence of this species within managed hunting clubs as reported by Miller and others (1975), water manager actions could potentially influence the growth and persistence of this species.

Joint-use Facilities Program

Physical actions proposed in the Joint-use Facilities Program alternative have the potential to affect Suisun thistle if the species is present along managed wetland distribution ditches. Comprehensive floristic surveys of managed wetlands could be conducted by a qualified botanist during the bloom time of this species and effects could be avoided through project relocations or realignments if the species is found.

Portable Pumps Program

Physical actions proposed in the Portable Pumps Program have the potential to affect Suisun thistle if the species is present along managed wetland distribution ditches. Comprehensive floristic surveys of managed wetlands could be conducted by a qualified botanist during the bloom time of this species and effects could be avoided through project relocations or realignments if the species is found.

Critical Habitat

There is no designated critical habitat for Suisun thistle in the project area.

Existing Environment and Cumulative Effects

The single largest effect on this rare plant has been the loss and fragmentation of historical tidal marsh habitat (Baye, personal communication, see “Notes”) (USFWS 1995a). Water management projects that alter natural hydrologic regimes may be affecting the species (USFWS 1995a).

Invasive species are directly affecting Suisun thistle. The two remaining populations of Suisun thistle are both being displaced by the spread of the invasive perennial peppergrass (Lepidium latifolium), and peppergrass spread is enhanced during high outflow and precipitation years (USFWS 1995a; Grewell, field notes 1992 through 1998). Rhinocyllus conicus is a weevil introduced by the US Department of Agriculture as a biological control for musk thistle and Italian thistle. *Rhinocyllus conicus* is known to have detrimentally affected native thistles across the United States (Louda 1998). Department of Water Resources biologists have discovered Rhinocyllus conicus adults and larvae on Suisun thistle at Rush Ranch which may limit this population through seed predation.

Conclusion and Determination

The assumption that Suisun thistle is limited to relict undiked tidal marsh has been questioned, as Soil Conservation Service reported the presence of this species in diked managed hunting clubs of Suisun Marsh in 1975. If Suisun thistle is present in diked managed wetlands, physical actions aimed at improving wetlands management within the diked marshes may directly affect this rare thistle. Actions such as

implementation of the water quality standards in the 1995 Water Quality Control Plan and September operation of the SMSCG also have the potential to affect this species, although the extent of these effects are unknown.

Larvae of the Phyiodes mylitta butterfly appear to damage vegetative portions of Suisun thistle (Grewell, field observations and larvae collection 1996). It is unknown if this herbivore is at a level which effects the reproductive success of Suisun thistle. Chronic pollution from oil spills in Suisun Bay, and the close proximity to both remaining populations to the Southern Pacific railroad tracks make these populations vulnerable to catastrophic loss from hazardous materials spills (USFWS 1995a). Suisun thistle is directly and indirectly vulnerable to mosquito abatement activities that involve ditch dredging, clearing of vegetation from mosquito ditch banks, and herbicide applications in tidal marshes.

Soft Bird's Beak, *Cordylanthus mollis* Gray subsp. *mollis*

Status

Soft bird's beak (*Cordylanthus mollis* Gray subsp. *mollis*) is listed as Endangered under the federal ESA, and as a rare plant under the California Endangered Species Act.

Distribution

Soft bird's beak was known historically from near the Antioch Bridge, but this small founder population was only observed once and did not persist (Mason 1972, Ruygt 1994). Soft bird's beak was also known from the Martinez shoreline (1881), Mare Island (1885, type locality), Napa Marsh, Petaluma Marsh, and Suisun Marsh in the San Francisco Estuary. This rare plant is endemic to the San Francisco Estuary and its current range is restricted to occurrences within Suisun Marsh, Contra Costa shoreline tidal marshes of Suisun Bay, Napa Marsh, and west to marshes near Point Pinole (Ruygt 1994).

Habitat

Soft bird's beak is restricted to a narrow lower high intertidal zone of fully tidal or muted tidal marsh (DWR 1994, Ruygt 1994, Fiedler and Zebell 1995). It is associated with the upper peripheral halophyte community including salt grass (Distichlis spicata), perennial pickleweed (Salicornia virginica), saltmarsh dodder (Cuscuta salina var. major), marsh lavender (Limonium californicum), and seaside arrowgrass (Triglochin maritima) (Ruygt 1994).

General Ecology

Soft bird's beak is a hemiroot parasite member of the figwort family (Scrophulariaceae) which has photosynthetic capability, but receives much of its water and part of its nutrient requirements from host plants (Chuang and Heckard 1971). The species is not host specific, but is most often found with salt grass and pickleweed.

Soft bird's beak is an annual plant which appears to have a persistent dormant seed bank, but the longevity of this cryptic life stage is unknown. Seed germination period varies with winter rainfall patterns, and seedlings have been observed between December and April in various years (Grewell, field observations and Ruygt, 1994). First flowering is usually observed in April, or more typically May, and continues with diminishing frequency until plants' senescence from late October through mid-November. Soft bird's beak is an obligately outcrossing species which is pollinated by a variety of bees (Ruygt 1994). Flower abundance and seed production appears to vary with degree of branching which is influenced by plant density and environmental factors (Ruygt 1994). Seed production per plant can be as high as 2600 seeds, but this production is reduced by seed predation (Ruygt 1994). It is assumed that local seed dispersal is most common, but there is the potential for long distance dispersal of seeds by high tide events. The appearance of small founder populations of soft bird's beak which are only observed for one year at locations such as the Antioch Bridge, at a few locations within Rush Ranch, and at the confluence of Hudeman Slough and Dutchman Slough in the Napa Marsh are examples of observations of this species which appeared for a short time but did not persist.

The single largest population of soft bird's beak is associated with the Hill Slough tidal marsh in Suisun Marsh (Ruygt 1994). This population accounts for more than 80% of the total estuary-wide occurrence of this species,

and is consistently much larger than any other known population. This large population was unknown until discovered by Department of Water Resources biologists (Grewell and Gaines, field notes 1992) suggesting at least the potential for other populations of this species in areas which have not been extensively searched. The narrow habitat requirements of this species, and the rarity of such habitat which has been most affected by wetlands fill and habitat degradation due to its proximity to upland edge, suggests that the overall status of this species is truly endangered.

Soft bird's beak was at one time presumed extinct following visits to known population sites after five consecutive wet years (Chuang and Heckard 1973).

There is evidence to suggest that drought years favor locally abundant populations of soft bird's beak. This may be due to the presence of more regeneration gaps in the plant community. It is also likely that the sustained high water levels on the marsh surface during wet water years may suppress germination or disperse seed out of appropriate germination sites. Several populations, such as the long term monitored population at Fagan Slough in the Napa Marsh have dramatically decreased in size during the above-normal water years of 1997 and 1998 (Baye, Grewell, Ruygt, field notes 1990 through 1998; CNPS Napa Marsh Cordylanthus monitoring results, 1972 through 1998).

Occurrence in the Project Area

Soft bird's beak is now limited to three locations within Suisun Marsh. This rare plant is found in the high marsh intertidal zone of the Potrero Hills tidal marshes. It is found both north and south of the eastern reaches of Hill Slough, at Rush Ranch, and in the tidal marsh regions of DFG's Joice Island unit. The species was known historically in the Peytonia Slough Ecological Reserve near the Southern Pacific Railroad tracks, and may still be present on private grazing lands west of the Peytonia Slough Ecological Reserve. A former population near the Montezuma Slough bridge is believed to be extirpated due to repeated human disturbances in this area.

Project Impacts

The following Amendment Three actions are not expected to affect soft bird's beak.

- Managed Wetlands Improvement Fund.
- Drought Response Fund.
- Morrow Island and Lower Joice Island fish screens.
- Roaring River Distribution System turnout repairs.
- Updating management plans.
- Water Manager Program.
- Joint-use Facilities Program.
- Portable Pumps Program.
- Converting S-35 and S-97 to monitoring stations.

Making Salinity Standards Consistent with the 1995 Water Quality Control Plan

It is uncertain whether channel water salinity standards in the 1995 Water Quality Control Plan will affect soft bird's beak. Field observations suggest that sustained increases in water levels associated with high delta outflow as experienced in the 1996 through 1998 water years may dramatically reduce population sizes of soft bird's beak. The population dynamics of this species are poorly under-

stood, and experimental studies to determine the effect of varying physical processes on the critical life stages of this rare plant have not been conducted. Field observations suggest that populations of the most common host plants of soft bird's beak are reduced and displaced by clonal Scirpus species in above-normal water years with higher than average depth and duration of flooding on the marsh surface. It is unknown whether actions needed to comply with the 1995 Water Quality Control Plan will have a negative effect on endangered bird's beak populations. Maintenance of species diversity and persistence of rare species such as soft bird's beak may be tied to maintenance of long term variability in hydrologic conditions.

Establishing Criteria for September SMSCG Operations

The September SMSCG Operations alternative has the potential to affect the soft bird's beak reproductive cycle, although there is uncertainty with regard to the magnitude of this effect due to the absence of scientific data which evaluates the influence of physical and biological processes on the critical life stages of this rare plant. The goal of September gate operations is to artificially freshen channel water salinity prior to flooding of lands for wintering waterfowl. September is historically one of the most saline periods of channel salinity in Suisun Marsh prior to onset of the fall rainfall. The incremental change in salinity and associated increases in water elevations during this time period have the potential to affect seed ripening, seed dispersal, and seed bank dynamics of this species. The details and extent of these effects are unknown.

Critical Habitat

There is no designated critical habitat for soft bird's beak in the project area.

Existing Environment and Cumulative Effects

The reduction and degradation of suitable habitat for soft bird's beak throughout the estuary is the single most significant threat to the continued existence of this species. Localized adverse affects associated with levee building, mosquito ditch maintenance and associated alterations of natural hydrology, and regional dampening of long term variability in estuarine salinity and hydrodynamics by water management actions all have the potential to affect soft bird's beak. Development of upland areas adjacent to tidal marsh can directly affect bird's beak by removing nesting areas for native bee pollinators (Parsons and Zedler 1996). The invasion of high intertidal marsh by perennial peppergrass (*Lepidium latifolium*) is a threat to soft bird's beak.

Potential effects to estuarine vegetation with implementation of the X2 standard was limited to an evaluation of potential persistence of tall emergent macrophytes (cattails and tules) along the bay shorelines (Collins and Foin 1993). These clonal species are adapted to persist, and actually thrive and expand in high outflow and long hydroperiod conditions. Unfortunately, an analysis of the effects of X2 standards did not include an evaluation of the effects of outflow regimes on the rare plant communities associated with high intertidal zones. Field observations suggest that in wet water years and extended periods of high outflow, tall emergent macrophytes which are physiologically adapted to high water elevations displace high marsh vegetation. Soft bird's beak is one species which has been displaced by Scirpus americanus (three-square bulrush) in wet water years (Grewell and Hickson, field observations 1993 through 1998). September SMSCG operations may have benefits for Suisun land managers, but these benefits may come at a cost to high inter-tidal plant communities which thrive at the more saline

end of the aqueous salinity gradient. Hydrodynamic and salinity alterations which deviate from historical seasonality and variability have the potential to affect rare halophytic plants such as soft bird's beak and its essential pickleweed and salt grass host plants.

Conclusion and Determination

Implementation of the 1995 Water Quality Control Plan standards, and September SMSCG operations are both alternatives of this project which could potentially affect soft bird's beak.

Delta Tule Pea, *Lathyrus jepsonii* Greene subsp. *jepsonii*

Status

Delta tule pea (*Lathyrus jepsonii* Greene subsp. *jepsonii*) is considered a species of concern by the USFWS and the California Department of Fish and Game. The California Native Plant Society includes delta tule pea on List 1B: Plants rare, threatened, or endangered in California and elsewhere.

Distribution

Delta tule pea occurs on the delta islands of the lower Sacramento and San Joaquin Rivers and westward through Suisun Bay, Suisun Marsh, Napa River marshes, and the wetlands around south San Francisco Bay (NDDB 1998). The plant has also been reported in San Benito and Fresno counties (CNPS 1994).

Habitat

Delta tule pea is a member of the legume family (Fabaceae). This robust perennial is native to freshwater and brackish marshes, and occurs along sloughs, riverbanks, and levees affected by tidal fluctuations. The species is most commonly observed near the water's edge on the outboard side of tidal slough levees. It also occupies tidal creek and slough banks of undiked tidal marshes. Suisun Marsh populations are often observed partially inundated at high tide. Delta tule pea is often associated with tall emergent macrophytes such as hardstem bulrush (Scirpus acutus) and cattails (Typha domingensis) within Suisun Marsh. The willow Salix lasiolepsis is often associated with delta tule pea in the Sacramento-San Joaquin Delta. Current habitat is often fragmented by sections of riprap on levees which do not support this emergent marsh community.

General Ecology

Delta tule pea is often observed entwined around California bulrush and hardstem bulrush at the water's edge, hence the name “tule” pea. Active vegetative growth for the season typically begins in April. By May of most years, the plants are of full stature and begin to bloom. In extremely mild winters, above ground biomass of this species may overwinter as has been observed to overwinter at Roe and Ryer Islands in Suisun Bay (B. Grewell, field observations). This is not typical, as the species normally dies back and disperses seed by late summer. Scientific studies of the demography of this rare plant have not been conducted. Very little detail is known of the critical life stage or habitat requirements of the species.

Occurrence in the Project Area

Department of Water Resources and Department of Fish and Game teams conducted fibristic surveys in the Western Salinity Control Project area in 1991, 1992, and 1993. A marsh-wide survey for the species was conducted in 1992 as part of the Suisun Marsh biological assessment for SWRCB. Surveys for delta tule pea were conducted during the May bloom period. Fringe tidal marshes along the outboard side of levees were surveyed from shallow-draft boats. Parallel transects were walked for extensive coverage of the larger undiked tidal marshes.

Delta tule pea is present throughout the Suisun Marsh (DWR 1994). Field surveys have located this species throughout most interior regions of the marsh. May 1993 surveys conducted by DWR and DFG staff mapped 19 colonies along Goodyear Slough, 94 Cordelia Slough colonies, one Ibis Cut colony, 49 Frank Horan Slough colonies, 21 Chadbourne

Slough colonies, and one Wells Slough colony (DWR 1994, 1992; 1993 DWR Suisun Marsh Planning project files; Brenda Grewell, rare plant maps). May 1992 DWR and DFG staff mapped 33 colonies along the main channel of Suisun Slough from Suisun City to the confluence with Grizzly Bay (DWR Suisun Marsh Planning project files; Brenda Grewell, rare plant maps). May 1992 surveys also documented locations of five Roos Cut colonies, three Hunter Cut colonies, and 24 Montezuma Slough colonies. Delta tule pea was also observed along main channels and small tidal creeks in the Cutoff Slough tidal marshes (Rush Ranch and DFG), Hill Slough east tidal marsh, Peytonia Slough Ecological Reserve, Lower Joice Island tidal marsh, Browns Island, Roe Island, and Ryer Island.

Project Impacts

The following Amendment Three actions are not expected to affect delta tule pea.

- Making salinity standards consistent with the 1995 Water Quality Control Plan.
- Drought Response Fund.
- Morrow Island and Lower Joice Island fish screens.
- Establishing criteria for September SMSCG operations.
- Converting S-35 and S-97 to monitoring stations.
- Water Manager Program.
- Updating management plans.

The installation and operation of the Morrow Island and Lower Joice Island fish screens and Roaring River Distribution System turnout repairs are also not expected to affect this species. Floristic surveys could be conducted from May through June bloom period to determine the presence of this perennial species, and any populations could be avoided to avoid effects for those actions which require construction.

Managed Wetlands Improvement Fund

Most of the actions associated with the Managed Wetlands Improvement actions are not expected to affect delta tule pea. However, the replacement or installation of tide gates in outboard levees has the potential to directly remove populations of delta tule pea. Floristic surveys could be conducted during May through June to determine the presence of this perennial species, and facilities could be located at alternative sites to avoid negative effects.

Joint-use Facilities Program

Joint-use Facilities Program alternatives have the potential to affect delta tule pea. Replacement or installation of tide gates in outboard levees has the potential to directly remove populations of delta tule pea. Floristic surveys could be conducted during May through June to determine the presence of this perennial species, and facilities could be located at alternative sites to avoid adverse effects.

Portable Pumps Program

Operation of the Portable Pumps Program alternatives are not expected to affect delta tule pea. However, the installation of tide gates in outboard levees has the potential to directly remove populations of delta tule pea and affect the species. Floristic surveys could be conducted during May through June to determine the presence of this perennial species, and facilities could be located at alternative sites to avoid adverse effects.

Critical Habitat

There is no designated critical habitat for delta tule pea in the project area.

Existing Environment and Cumulative Effects

Extensive levee work and fish screen installation in Suisun Marsh have likely removed water side populations of this rare plant, because floristic surveys for the presence of this plant at proposed project sites are not routinely conducted in Suisun Marsh. Additional potential threats to delta tule pea populations include dredging close to shorelines, deposition of dredge spoils on levee banks of tidal sloughs and managed wetlands distribution ditches, adding riprap to outboard levees, oil spills, accelerated erosion caused by jet skis and excessive motor boat wake, and agricultural grazing along tidal slough banks (DFG 1998, CNPS 1998).

Conclusion and Determination

Cost-share and Joint-use Facilities actions which involve placement of tide gate structures in outboard levees have the potential to directly affect delta tule pea populations. With careful project planning, facilities could be sited to avoid these effects. Any projects which increase the linear footage of riprap along Suisun levees also have the potential to affect local populations of delta tule pea.

Mason's Lilaeopsis, *Lilaeopsis masonii* (Mathias and Constance)

Status

Mason's lilaeopsis (*Lilaeopsis masonii* Mathias and Constance) is considered a species of concern by the USFWS. This plant is also listed as rare under the California Endangered Species Act. CNPS includes this species on List 1B: Plants rare, threatened, or endangered in California or elsewhere.

Distribution

Mason's lilaeopsis is found in the intertidal zone of freshwater and brackish marshes of the delta, Suisun Bay, Suisun Marsh, Mare Island, Carquinez Straits, and the Napa River from Mare Island Straits north to the city of Napa. A herbarium voucher specimen was collected from Tomales Bay at Chicken Ranch Beach. This historical population has not been relocated in recent years (Golden and Fiedler 1991). There is a relationship between channel water salinity and the distribution of Mason's lilaeopsis. Other environmental variables such as mean tidal elevation, tidal range, soil type, and active bank erosion also influence the distribution. The species drops out in the northern delta where tidal ranges dampen out. Within Suisun Marsh, Mason's lilaeopsis appears to be most abundant in the northern, central, and eastern regions of the marsh and Suisun Bay.

Habitat

Mason's lilaeopsis habitat is restricted to the intertidal zone of freshwater and brackish marshes. It is most common on actively eroding slough banks, wave cut beaches, or earthen levees with a clay substrate. However, it has also been observed on rotting wood (pilings or emergent snags), and in sand along the edges of waterways. Observations of population positions on exposed mud banks indicate a growth zone above the high and low tide equilibrium point (zero flood level). The habitat of Mason's lilaeopsis is transient and varies as a function of bank stability and changing water salinity.

General Ecology

Mason's lilaeopsis is a member of the Apiaceae (carrot) family. It is a low-growing, glabrous herbaceous perennial which spreads laterally by rhizomes. The plant appears grass-like from a distance and is often associated with a complex low turf community with three-ribbed arrowgrass (*Triglochin striata*), low club rush (*Scirpus cernuus*), and marsh penny-wort (*Hydrocotyle verticillata*). It also co-occurs with the rare delta mudwort (*Limosella subulata*) at Brown's Island and in the Sacramento-San Joaquin delta. Leaves are reduced to threadlike, linear, or reduced phyllodes that form dense tufts along horizontal rhizomes. Leaves bear characteristic transverse septa. Weak flowering branches are usually shorter than the leaves, and bear three to eight small, white flowers in simple umbels. Flowering period for the species extends from April through October.

Plants are inundated twice daily by high tides, and are exposed during low tides. The plants are photosynthetically active during daylight low tide exposures. The plant occurs in areas with active bank erosion, and tolerates these disturbances by its ability to spread laterally by rhizotomatous growth (Golden and Fiedler 1991). Populations may be composed of clonal colonies as floating clonal tufts (ramets) break away from the eroding channel, float with the tides, and colonize on other suitable bank habitat. Ramets of Mason's lilaeopsis were seen

floating in the delta region, supporting the colonization theory (Golden and Fiedler 1991). Ramets were also seen floating in Roos Cut and Suisun Slough during DWR and DFG surveys in 1992 (DWR 1994). Populations may also establish through tidal seed dispersal. Evidence of colonization, local extinction, and recolonization suggests a metapopulation structure which relies on movement of local populations along reaches of disturbed channel banks (B. Grewell, field observations).

Occurrence in the Project Area

Department of Water Resources and Department of Fish and Game survey teams have conducted Mason's lilaeopsis surveys throughout Suisun Marsh from shallow draft boats at low tide. These surveys have not been repeated since 1993, but were conducted from 1990 through 1993 in support of the Western Suisun Marsh Salinity Control Project and an earlier biological assessment for the State Water Resources Control Board. The 1992 surveys were the most extensive, and included the low tide exposed intertidal zone of all interior Suisun Marsh channels, Suisun Bay island shorelines, and the shores of Suisun Bay, Grizzly Bay, Honker Bay, and Little Honker Bay. All navigable tidal reaches of these waterways were censused for Mason's lilaeopsis.

Field surveys have located Mason's lilaeopsis throughout most regions of the marsh. Mapped populations included colonies along the south bank of Ibis Cut, five populations along Frank Horan Slough, three populations on Chadbourne Slough, three populations on Goodyear Slough near Suisun Slough, and one population on the north bank of Roos Cut near Suisun Slough. Forty-four populations were recorded along Suisun Slough from Wells Slough south to Grizzly Bay. Numerous populations were observed along Suisun Slough from Wells Slough north to Suisun City. The highest density of this rare plant was observed along the reaches of Suisun Slough and Montezuma Slough where active slump blocks were eroding from the channel banks. The populations along Suisun Slough range in size from 0.6 to 1097 meters of horizontal coverage along the channel banks. The largest continuous population was observed along the west bank of Suisun Slough south of Sheldrake Slough west of the extensive Rush Ranch tidal marshes and Cutoff Slough. Four colonies of Mason's lilaeopsis were recorded along the north and south banks of Goodyear Slough near the confluence with Cordelia Slough in May 1993 (DWR, Field Notes May 26, 1993). Mason's lilaeopsis has not been observed downstream of the first 300 meters of Goodyear Slough. Mason's lilaeopsis has not been observed along the entire length of Cordelia Slough between 1990 and 1998.

Project Impacts

The following Amendment Three actions are not expected to affect Mason's lilaeopsis.

- Drought Response Fund.
- Roaring River Distribution System turnout repairs.
- Morrow Island and Lower Joice Island fish screens.
- Updating management plans.
- Converting S-35 and S-97 to monitoring stations.
- Water Manager Program.
- Making standards consistent with the 1995 Water Quality Control Plan.
- Portable Pumps Program.

Channel water salinity standards associated with the 1995 Water Quality Control Plan are not expected to affect Mason's lilaeopsis, as this species occupies a range of aqueous salinity which is both more fresh and more saline than the interior of Suisun Marsh.

The installation of Morrow Island and Lower Joice Island fish screens is not expected to affect Mason's lilaeopsis. This species has not been found near the MIDS intake to date. Floristic surveys will be conducted near the intake of MIDS during the planning stages of fish screen design to confirm that Mason's lilaeopsis is not in this location.

Establishing Criteria for September SMSCG Operations

September SMSCG operations are not expected to affect Mason's lilaeopsis in most regions of Suisun Marsh. Stoplog placement and gate closures do alter tidal regimes, and changes in intertidal flooding regimes near the SMSCG have the potential to affect populations of Mason's lilaeopsis along Montezuma

Slough close to the SMSCG. Mason's lilaeopsis occupies a narrow band of the intertidal zone and slight artificial increases in water elevations associated with gate operations could affect local populations.

Managed Wetlands Improvement Fund

Most of the specified actions in the Managed Wetland Improvement Fund will not affect Mason's lilaeopsis. Although the relocation of discharge facilities, such as slide and flap gates on the exterior levees may affect this species by direct removal of Mason's lilaeopsis populations, these effects could be avoided through careful siting of the facilities following low tide surveys from the channel designed to specifically map and then avoid these rare plants.

Joint-use Facilities Program

The Joint-use Facilities Program for cooperative use of water delivery systems may include new shared exterior drainage gates. Installation of these drainage tide gates in exterior levees has the potential to directly affect populations of Mason's lilaeopsis. These effects could be avoided through careful siting of the facilities following low tide surveys from the channel designed to specifically map and then avoid these rare plants.

Critical Habitat

There is no designated critical habitat for Mason's lilaeopsis in the project area.

Existing Environment and Cumulative Effects

Some populations of Mason's lilaeopsis, which were mapped in Suisun Marsh during 1990 through 1993 surveys have been filled and extirpated. Populations documented at the northern terminus of Suisun Slough were covered with riprap during the Suisun City waterfront and marina improvement project construction (DWR Field Maps, B. Grewell field notes). A population of Mason's lilaeopsis was filled at the confluence of McCoy Creek and the Lawler Ranch Subdivision Buffer Ditch when the tide gates were removed from the terminus of the Lawler Ranch Buffer Ditch in 1996 (Field Notes, B. Grewell, DWR, D. Hickson, DFG). Extensive levee work and fish screen installation in Suisun Marsh has likely removed other water side populations of this rare plant, as low tide surveys for the species must be conducted from the water to ascertain its presence before projects proceed.

Accelerated erosion from extreme flood events is an additional potential cause for movement of existing populations of Mason's lilaeopsis. These naturally removed populations have the

potential to recolonize in suitable habitat downstream of the erosion sites.

Additional potential threats to Mason's lilaeopsis populations include dredging close to shorelines, deposition of dredge spoils on levee banks of tidal sloughs, adding riprap to outboard levees, oil spills, accelerated erosion caused by jet skis and excessive motor boat wake, and agricultural grazing on shorelines (DFG 1997). Changes to the natural processes that sustain suitable habitat including changes to the tidal regime, water velocity, water salinity, and erosion processes are also affecting the species (Golden and Fiedler 1991).

Conclusion and Determination

Cost-share and Joint-use Facilities actions which involve placement of tide gate structures in outboard levees have the potential to directly affect Mason's lilaeopsis populations. With careful project planning, facilities could be sited to avoid these effects. Also, any projects which increase the linear footage of riprap along Suisun levees have the potential to affect local and regional metapopulations of Mason's lilaeopsis. September operation of the SMSCG facility could locally affect Mason's lilaeopsis populations along Montezuma Slough due to changes in tidal regimes.

Continued efforts to upgrade levees and replace tidal structures on the outboard sides of levees within the delta, Suisun Marsh, and Napa Marsh may further fragment historical metapopulations of Mason's lilaeopsis. Some of the actions relative to this SMPA Amendment are expected to contribute to these regional effects.

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